DAF ENGINES

VDT-I-DAF 006 En

DHS 825, DHT 825 and DHTD 825

12.1982
(Replaces Ed. 2.1982)

Tightening torque of the bracket for fastening the nozzle-holder assembly

For fastening the nozzle-holder assembly KBEL 100 S 29 - 0 431 214 992 (DHK 0 432 291 694 and 702) to the above mentioned engines, DAF uses not only the Bosch bracket 2 435 703 103, but also its own bracket (DAF no. 654 041).

On account of the plastic deformation the fastening nut of the DAF bracket can only be tightened to a maximum of 15 Nm. The tightening torque for both fastening brackets has therefore been prescribed at 10 ... 15 Nm.

BOSCH

A1

FIAT ENGINES 8260.02.., 8280.02..

VDT-I-FIA 016 En
12.1979

Leakages in fuel-injection tubing

With the injection-pump assemblies

Injection pump	Injection-pump assembly	for engine
PE 6 P 120 A 720 LS 3803	0 401 846 719	8260.02..
PE 8 P 120 A 920/5 LS 3801	0 401 848 703	8280.02..
PE 8 P 120 A 920/5 LS 3801	0 401 848 704	8280.02..

the fuel injection tubing may have leakages.

If this is the case, the delivery-valve holder and the delivery-valve assembly must be modified. New fuel-injection tubing, which must be purchased from a FIAT registered dealer, must also be fitted.

The following parts are required for the modification to the fuel-injection pump:

Part	Part no. old	Item in service part list	Part no. new
Delivery-valve holder	2 413 371 057	8	2 413 371 108
Delivery-valve assembly	2 418 554 027	13	2 418 554 049
Washer	-	123	2 410 200 015

The new delivery-valve holder is fitted with a return-flow throttle.

The washer should be fitted between the delivery-valve holder and the filler piece.

The setting of the pressure-spring pre-tension remains unchanged at 2.5 mm.

The test values remain the same.

When the modification has been carried out the designation of the fuel-injection pump and the part number of the injection-pump assembly must be changed.

Fuel-injection pump old	new	Injection-pump assembly old	new
PE 6 P 120 A 720 LS 3803	..3806	0 401 846 719	..726
PE 6 P 120 A 920/5 LS 3801	..3804	0 401 848 703	..715
		0 401 848 704	..718

When repairing the injection-pump assembly and when the customer so wishes, this change should be carried out.

The modification must be paid for by the customer.

BOSCH Geschäftsbereich KH, Kundendienst: Kfz-Ausrüstung.
© by Robert Bosch GmbH, D-7 Stuttgart 1, Postfach 50. Printed in the Federal Republic of Germany.
Imprimé en République Fédérale d'Allemagne par Robert Bosch GmbH.

C27 18

A2

This information is available only in German. If necessary, please contact your regional representative.

Cette information n'est disponible qu'en allemand. Le cas échéant, veuillez vous adresser à votre représentation régionale.

Esta información está disponible únicamente en alemán. En caso necesario, sírvase dirigirse a su Representación Regional.

Questa informazione è disponibile solo in lingua tedesca. Se necessario, rivolgersi al proprio rappresentante di zona.

A3

BOSCH Service-Information

Kenntnis genommen: Bearbeiter Inhaber Meister Mechaniker

An VH, AV/S, BG, BD, BV

VD1 - I - FOR 001 B

July 1972

Ford-Transit with 2.4 l diesel engine

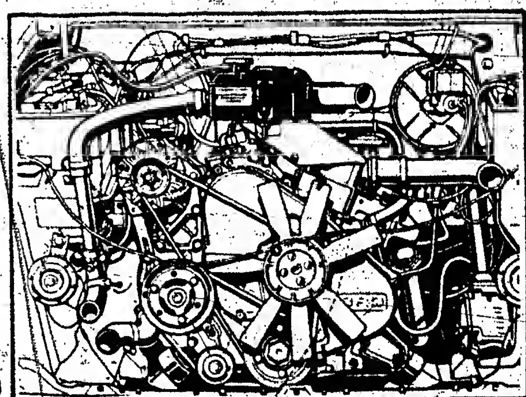
Ford has introduced various new vehicle models in the Ford-Transit series equipped with the York diesel engine. In various countries, currently Germany and Austria, these engines are fitted with Bosch fuel injection equipment from the well-known model series PES 4 M.. with EP/RSV.. governor and EP/SAZ.. timing device.

This bulletin will provide you with information and instructions pertaining specifically to this vehicle model for the removal and installation of the fuel injection pump.
We assume an adequate level of training and knowledge concerning this type of work.

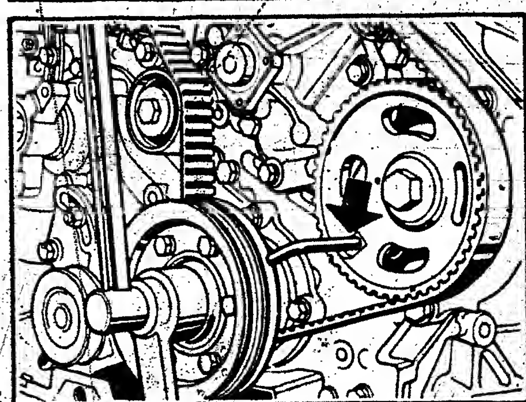
1. Removal of the Fuel Injection Pump

Before the protective hood (5 cross-recessed screws) for the toothed belt can be removed, the radiator (4 screws), the hood (4 screws), the headlamp decorative rims (1 screw each), and the radiator grill (on each side 2 screws above and 2 screws in the wheel box, grounding straps above for the head lamps, bowden cable for the hood catch) must all be removed (Fig. 1).

Remove the fan wheel with intermediate adaptor and V-belt pulley (4 screws) and the V-belt pulley (4 screws) on the vacuum pump. Remove both V-belts. The protective hood can now be taken off.

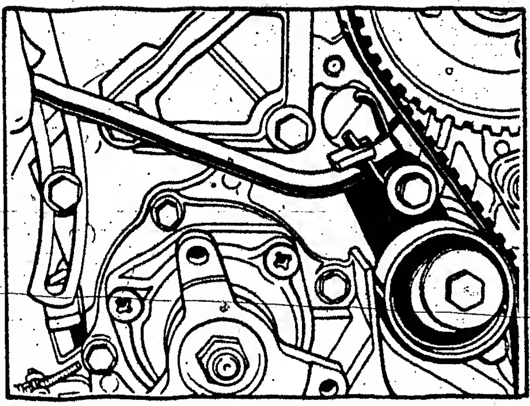


1



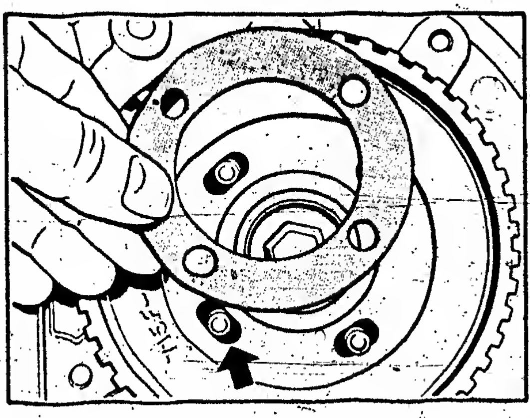
2

Using a box wrench or a socket wrench at the front crankshaft bolt, turn the engine over – in the direction of normal engine rotation only (if turned in the opposite direction the toothed belt could jump a tooth). Insert the blocking pin (prepare as shown in Sketch No. 1) into the hole provided for it in the camshaft and engine block (arrow). In order to do this, the mark below on the engine block must line up with the notch on the crankshaft wheel and the line on the fuel injection pump flange must line up with the graduated scale on the timing device.



3

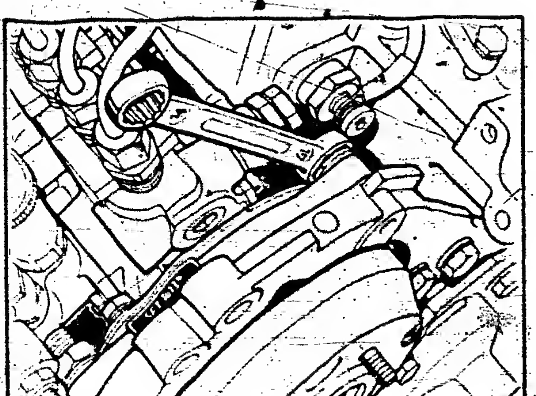
Loosen the two screws on the belt tightener while counterholding, at the back, the nut on the through-bolt to the roller fastener. Using the bent lever (prepare according to Sketch No. 2), release the tension on the roller and tighten the screw on the roller fastener in this position.
The toothed belt can now be removed.



4

After removing the 4 nuts, the spring rings, and the large plain washer on the fuel injection pump drive wheel, the slots provided for fine adjustment of the port closing, „FB" (arrow) can be seen.

The variable speed governor on the fuel injection pump is fastened to the engine block with a bracket for support.



5

Important!

Bolt the fuel injection pump in place only at the large flange!
The bearing for the injection pump camshaft is located in this flange. In the pump mounting flange there are two rubber rings for the oil channels.

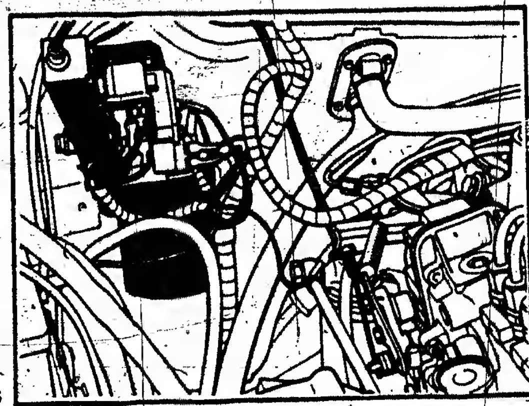
Plate marked in degrees for port closing adjustment.

Never turn the engine over when the toothed belt has been removed!
If the engine is turned over with the belt off, pistons could strike against open valves and cause damage!

2"

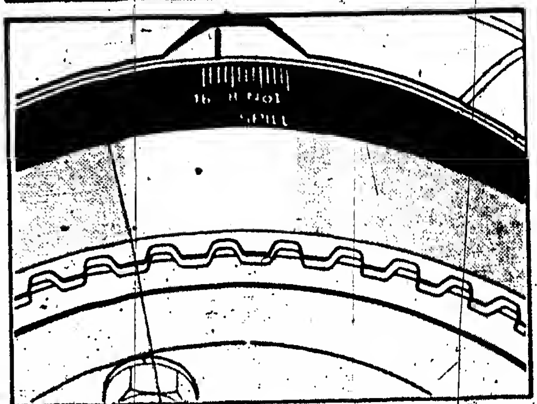
A5

Stopping device.
This diesel engine is operated by the switching on and off of the ignition switch.



6

2. Installation of the Fuel Injection Pump



7

Do not forget the O-rings for the oil channels in the mounting flange!

Set pump to the FB point, 12 or 13° depending on the reading of the plate shown in Fig. 5. Fasten the drive wheel by hand so that the bolts are in the center of the slots.

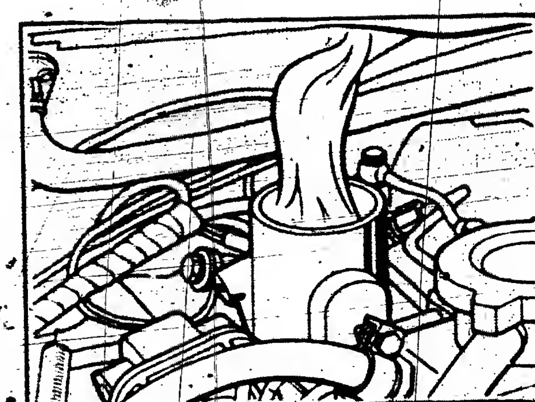
Replace the toothed belt working around in the opposite direction to that of normal engine rotation. Be sure that the belt is tight between the crankshaft, camshaft, and fuel injection pump drive wheel.

If the FB point should have shifted as a result of unfavorable positioning of the belt, the setting can be corrected by turning the injection pump (with flange) in the slots.

Important! Remove the blocking pin!

Loosen the screw on the jockey pulley. Turn the engine over, at the crankshaft bolt, about twice in the normal direction of rotation so that the fan belt teeth seat correctly. Tighten both screws while again counter-holding the roller fastener nut.

Replace all other parts in the sequence opposite that followed when they were removed.



8

When starting the engine – has the blocking pin been removed? – with the air filter off (Caution – danger of fire!) be sure that any flames which might flash upward from the inlet manifold (Fig. 8) do not burn the cable harnesses and plastic tube above it.

A6

3. Repair and Testing

The following Technical Documents have been prepared:

Service List L-FOR 2.4/1-1;
provisional Service Parts lists;
provisional Offer Sheet for Repair Tools KDEP 1 B, dated Aug. 71;
Offer Sheet for Testing Tools KDEP 19, dated April 72;
Offer Sheet for Testing Tools VDT-AHF 295B, Sheet 1 - 3 and WA Information Bulletin EFEP.../5, dated 4 Nov. 71;
Test Specifications VDT-WPP 001/4-FOR 2.4a;
Repair Instructions VDT-WJP 101/2 B, 1st Supplement;
Test Instructions VDT-WPP 001/4 B, 2nd Supplement and VDT-WPP 222/3 B, 1st Supplement.

4. Store for Reconditioned Items

In the special store for reconditioned items we have made EP assemblies 0 400 084 008 ... 009 available for special cases arising in conjunction with costumer service according to ETA List 121/1, Sheet 14/3.

5. SIMMS — Bosch Replacement

Simms fuel Injection pumps which have been installed can be replaced if necessary by Bosch pumps. These pumps are Fuel Injection Pump Assembly 0 400 084 008 for the 62-HP (full-rate) York engine and Assembly 0 400 084 009 for the 51-HP (de-rated) York engine.

In both cases, the fuel lines must be changed and the support bracket (Ford Order No. 1 512 228) for the variable speed governor must be mounted on the engine block.

6. Warrantly

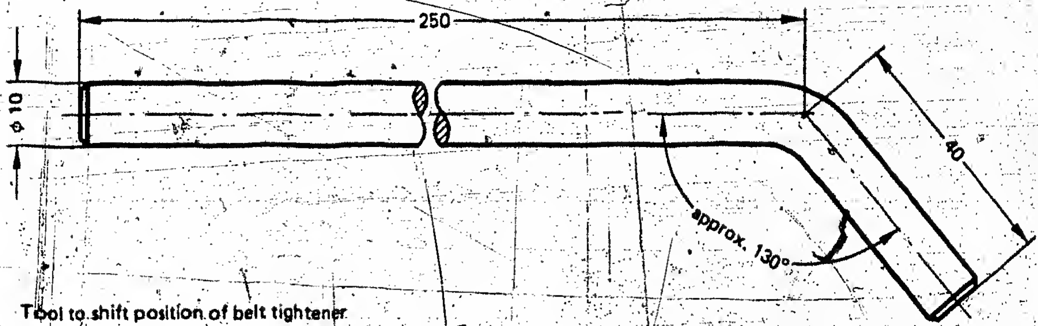
We have reached an agreement with Ford concerning service procedure.

Outside Germany* we conform to the Ford warranty periods which vary from location to location, but only up to a maximum of 12 months or 50,000 km. Information on the warranty period for your country will be given to you by the Ford dealer in your location. If this information is not provided, the warranty period of 6 months or 10,000 km applies, as specified in our Lieferbedingungen (Delivery Conditions) Z 16.

* We point out particularly that we reimburse no removal and installation costs in foreign countries.

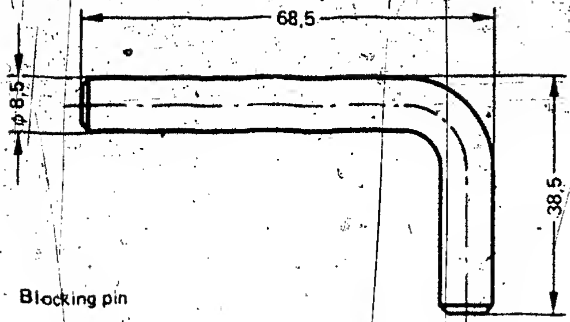
7. Special Tools (manufacture locally)

Sketch No. 2



Tool to shift position of belt tightener

Sketch No. 1



Blocking pin

ϕ = dia.

8. Work Units (AW)

Until final work units are provided in Folder VDT-WJA 020/1, please be guided by the following provisional work unit figure.

Removal and installation of fuel injection pump:
33 works units

This includes:
removal and installation of radiator,
bleeding fuel circuit.

The major Ford dealers have provided replacement assemblies for cases of emergency. It is expected that in view of their many years of experience the Bosch service stations will assist immediately in such cases. We have taken steps to assure that the service parts and tools required for initial planning can be delivered from the warehouse.

Robert Bosch GmbH
Geschäftsbereich K-Ausrüstung
Handel
Kundendienstberatung

HATZ ENGINES E 75/79, E 780, E 950 with
DIESEL KIKI fuel-injection pumps PFR1K.. 0 414..

VDT-I-HAT 001 En
9.1980
Replaces Ed. 6.1980

Since January 1980, Hatz have been fitting fuel-injection pumps manufactured by Diesel-Kiki (DKKC) in the above-mentioned engines. These pumps have the same designation as the corresponding BOSCH product. In order to differentiate, there are the letters "NP" in front of the type designation on the nameplate, e.g. NP-PFR 1 K80 A 458.

1. After-sales service

You should carry out after-sales service work in the same way as for Bosch products.

2. Function

These fuel-injection pumps are functionally similar to those manufactured by Bosch, but may have constructional differences. They are interchangeable.

3. Technical documentation

The existing test and repair instructions as well as test values apply also to the DKKC pumps.
The plunger lift to port closing however is not carried out by means of rollers with different diameters, but by means of spring seats with various thicknesses.

4. Service parts

Due to constructional differences, separate service parts lists (microfiches) are produced for the DKKC pumps. The difference to the Bosch lists is the "NP" next to the type designation or part number. Only these lists may be used for service part ordering. Service parts are ordered in the usual way.

5. Warranty

The warranty conditions and procedures with which you are already familiar apply here as well. The date of manufacture (identical code to that of Bosch) is given on the nameplate.

BOSCH
Geschäftsbereich KH, Kundendienst Kfz-Ausrüstung
by Robert Bosch GmbH D 7 Stuttgart 1 Postfach 50 Printed in the Federal Republic of Germany
Imprimé en République Fédérale d'Allemagne par Robert Bosch GmbH

Fuel-injection equipment

IVECO-SOFIM ENGINE 8140.21 in CV*

VDT-I-IVE 002 En

10.1985

Installation instructions for single-sided progressive compression spring 2 434 614 027 of nozzle-and-holder assembly 0 432 191 829

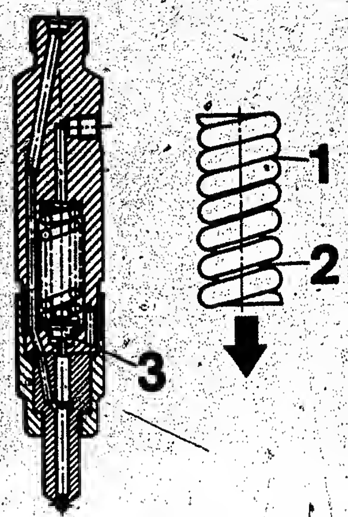
The compression spring is a spring with variable spacing between turns.
To guarantee the effectiveness of this progressiveness as the nozzle-opening pressure builds up, the end of the spring with the large gap between turns must point toward the pressure spindle when being inserted in the nozzle holder (see drawing).

* CV = Commercial Vehicles

Motor Vehicle Service Information

BOSCH

Geschäftsbereich KH. Kundendienst Kraftfahrzeug-Ausrüstung.



1 = small space between turns
2 = large space between turns
3 = Pressure spindle

Please direct questions and comments concerning the contents to our authorized representative in your country.

KHD VDT-I-KHD 002 B

March 1976

Engines F 4 L 912, F 6 L 912 with Diesel-Kiki injection-pump assemblies

In 1975 KHD fitted in the above engines not only Bosch injection-pump assemblies, but also some manufactured in Japan by Diesel-Kiki (DKC). These assemblies should be treated like Bosch equipment for the purposes of after-sales service. The assemblies detailed under "1. Equipment" are identical in mounting and operation, and are interchangeable.

1. Equipment

Bosch	DKC
PES 4 A 75 D 410/3 RS 1183 + EP/RSV 325 . . . 1150 A 8 B 494 DL = 0 400 464 052	NP-PES 4 A 75 D 410/3 RS 1310 + NP-EP/RSV 325 . . . 1150 A 8 B 755 DL = 0 400 464 108
PES 4 A 80 D 410/3 RS 1183 + EP/RSV 325 . . . 1150 A 8 B 298 DL = 0 400 464 094	NP-PES 4 A 80 D 410/3 RS 1310 + NP-EP/RSV 325 . . . 1150 A 8 B 1093 DL = 0 400 464 109
PES 4 A 75 D 410/3 RS 1183 + EP/RSV 325 . . . 1400 A 8 B 742 DL = 0 400 464 104	NP-PES 4 A 75 D 410/3 RS 1310 + NP-EP/RSV 325 . . . 1400 A 8 B 761 DL = 0 400 464 110
PES 6 A 75 D 410/3 RS 1197 + EP/RSV 325 . . . 1400 A 8 B 495 DL = 0 400 466 046	NP-PES 6 A 75 D 410/3 RS 1311 + NP-EP/RSV 325 . . . 1400 A 8 B 756 DL = 0 400 466 082
PES 6 A 75 D 410/3 RS 1197 + EP/RSV 325 . . . 1000 A 8 B 1032 DL = 0 400 466 063	NP-PES 6 A 75 D 410/3 RS 1311 + NP-EP/RSV 325 . . . 1000 A 8 B 1095 DL = 0 400 466 083
PES 6 A 75 D 410/3 RS 1197 + EP/RSV 325 . . . 1000 A 8 B 588 DL = 0 400 466 065	NP-PES 6 A 75 D 410/3 RS 1311 + NP-EP/RSV 325 . . . 1000 A 8 B 758 DL = 0 400 466 084
PES 6 A 75 D 410/3 RS 1197 + EP/RSV 325 . . . 900 A 7 B 602 DL = 0 400 466 068	NP-PES 6 A 75 D 410/3 RS 1311 + NP-EP/RSV 325 . . . 900 A 7 B 759 DL = 0 400 466 085
PES 4 A 80 D 410/3 RS 2346 + EP/RSV 325 . . . 1400 A 8 B 1022 DL = 0 400 864 029	NP-PES 4 A 80 D 410/3 RS 2476 + NP-EP/RSV 325 . . . 1400 A 8 B 1094 DL = 0 400 864 037
PES 4 A 80 D 410/3 RS 2346 + EP/RSV 325 . . . 1400 A 8 B 540 DL = 0 400 864 030	NP-PES 4 A 80 D 410/3 RS 2476 + NP-EP/RSV 325 . . . 1400 A 8 B 757 DL = 0 400 864 038

BOSCH Geschäftsbereich KH Kundendienst Kfz-Ausrüstung
© by Robert Bosch GmbH, D-7 Stuttgart 1, Postfach 50. Printed in the Federal Republic of Germany
Imprimé en République Fédérale d'Allemagne par Robert Bosch GmbH

2. Service Parts

You can order service parts in the usual way. The service parts lists are available on microfiche.

3. Warranty

The already-familiar warranty period and procedural regulations are valid. The first two positions in the production number represent, in the form of a number/letter combination, the date of manufacture.
The first position represents the month, as follows:

1 = January, 2 = February, 3 = March, 4 = April,
5 = May, 6 = June, 7 = July, 8 = August,
9 = September, 0 = October, Y = November,
Z = December.

The second position represents the year, as follows:

K = 1974, L = 1975, M = 1976 etc.

The 3rd to 9th positions (1 letter, followed by numbers) represent the actual production number.

Example: 3 LD 912 618 = March 1975.

4. Technical Documentation

The following Bosch technical publications can be used:

Repair instructions

VDT-WJP 101/1 B
VDT-WJP 101/1 B 1st suppl.
VDT-WJP 211/5 B

Test Instructions

VDT-WPP 001/4 B
VDT-WPP 001/4 B 1st suppl.
VDT-WPP 110/2 B

Test Specifications

Provisionally, the Diesel Kiki assemblies can be tested using VDT-WPP 001/4 KHD ... for the corresponding Bosch pump.

In case of inquiry, please contact your authorized representative.

KHD engines F3 L 912, F4 L 912, F6 L 912 with
DIESEL-KIKI fuel-injection assemblies NP-PES.. 0 400..

Since January 1980 KHD have been fitting Diesel-Kiki (DKKC) original equipment fuel-injection assemblies into the above mentioned vehicles. These fuel-injection assemblies have the same designation as the corresponding Bosch product. In order to differentiate the letters "NP" are stamped on the type plate before the type designation, e.g.: NP-PES 3 A80 D410/3 RS 1324
NP-RSV 326.. 1400 AB 495 DL

1. After-sales service

After-sales service work should be carried out in the same way as for Bosch products.

2. Function

The fuel-injection equipment is the same as that produced by Bosch as regards its functioning, but may have constructional differences. They are interchangeable with each other.

3. Technical documentation

The existing Bosch test and repair instructions as well as test values apply also to the DKKC fuel-injection equipment.

The shutoff or idle stop, however, is in a different place (see Figs. 1 and 2). When the flyweight assembly is loosened the pin wrench KDEP 2998 may not fit into the slot of the round nut (tolerance exceeded). In this case the pin wrench must be modified accordingly.

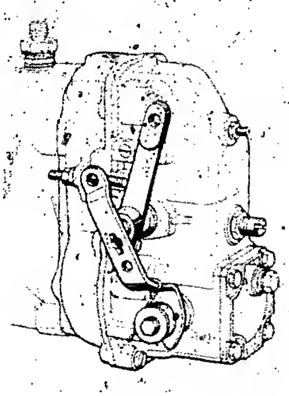
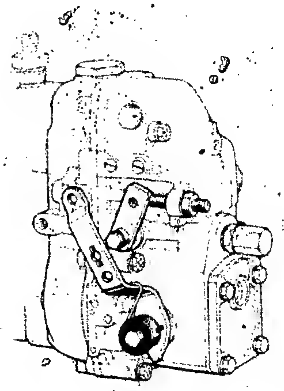


Fig. 1

Bosch



DKKC

Fig. 2

BOSCH Geschäftsbereich KH Kundendienst Kfz-Ausrüstung
by Robert Bosch GmbH, D-7 Stuttgart 1, Postfach 50. Printed in the Federal Republic of Germany
Imprimé en République Fédérale d'Allemagne par Robert Bosch GmbH

4. Service parts

Due to constructional differences separate service-part lists (microfiches) are produced for DKKC fuel-injection equipment. The difference from the Bosch lists is the "NP" next to the type designation. Only these lists may be used when ordering service parts. Service parts can be ordered in the usual manner.

5. Guarantee

The guarantee conditions and procedure regulations with which you are already familiar apply here as well. The date of manufacture (decoded exactly like the Bosch FD) is given on the type plate.

KHD ENGINES, MODEL SERIES (B) F...L 912/913 VDT-I-KHD 004 En

with wet-sump lubrication of the injection-pump assembly 9.1981

Supersedes Ed. 6.1981

As from date of manufacture FD 144, the injection-pump assemblies with RSV governor have been fitted with a sheet-metal closure cover 1 421 038 001 without oil-level check screw.

If, in the case of KHD-engines (B) F...L 912/913, the injection-pump assembly, or governor, with wet-sump lubrication have to be replaced, the old cast-metal closure cover 1 421 060 007 is to be retained and screwed into the new injection-pump assembly in order that the oil level can still be checked.

BOSCH Geschäftsbereich KH Kundendienst, Kfz-Ausrüstung
© by Robert Bosch GmbH, D-7 Stuttgart 1, Postfach 50. Printed in the Federal Republic of Germany
Imprimé en République Fédérale d'Allemagne par Robert Bosch GmbH

MACK COMMERCIAL VEHICLES, EUROPEAN MODEL
with ETA (B) 676 B engine

VDT-I-MAC 002 En
6.1980
Supersedes Ed. 6.77

MACK Trucks Inc. delivers this 6-cyl. in-line engine rated at 218 kW (296 DIN PS) at 2100 min⁻¹. Injection sequence 1-5-3-6-2-4.

1. Fuel-injection equipment

The injection-pump assembly is also available as a set together with nozzle-and-holder assemblies and connection parts.

Injection-pump assembly	Fuel-injection pump	Governor
0 402 036 704 Set 705	PES 6P 110A 720/3 RS 3036	0 421 815 131 RQV 300/600..1050 PA 366 KR
706 Set 707	3036	0 421 815 130 RQV 300/600..1050 PA 365 KR
708 Set 709	3036	0 421 815 129 RQV 300/600..1050 PA 364 KR
9 400 231 020 Set 021	3036	9 420 232 005 RQV 300/600..1050 PA 447 KR
026 Set 027	3036	9 420 232 008 RQV 300/600..900 PA 453 KR
032 Set 033	3036	9 420 232 011 RQV 300/600..1050 PA 462 KR

Nozzle-and-holder assy.	Nozzle-holder assembly	Nozzle	Nozzle opening pressure
0 432 191 879	0 431 112 997	0 433 171 006 DLLA 155 P 5	300^{+10}_{-0} bar
9 430 233 001	0 431 112 997	0 433 171 010 DLLA 160 P 9	300^{+10}_{-0} bar

The injection-pump assemblies are not fitted with Bosch supply pump. A supply pump is used which is driven by the truck engine.

2. Explanation of engine type designation

E T A B 67 6 B

- B — Output identification letter
- 6 — Identification number for high torque increase
- 67 — Engine swept volume (672 cu in (11.01 liter)
- B — Engine brake DYNATARD
- A — After-cooled (charge cooling)
- T — Turbocharged
- E — Engine

3. After-sales service notes

This engine can be provided with various auxiliary units which influence, or are influenced by, the injection-pump assembly.

MPL (Mack Puff Limiter)

The MPL is a pneumatic device which is fitted outside the fuel-injection pump. It acts directly on the control rod via an air cylinder, irrespective of the governor position.

At low intake-manifold pressure e.g. during acceleration, the maximum possible injected fuel quantity is determined by the air cylinder and not by the governor. This system contains two basic assemblies, the reversible servo valve and the air cylinder with which the piston is retracted to the non-operating position. The reversible servovalve is provided with one connection each to the supply pressure of the brake system downstream of the master brake valve, air cylinder and intake manifold. It supplies the air cylinder with a pressure signal which decreases in direct proportion to the intake-manifold pressure.

The reversible servovalve is provided with a constant supply of compressed air during operation. Its design means that it always permits leaks, so the park braking system must always be actuated when the truck is parked. Similarly, the park braking system must always be actuated when starting the engine in order that full starting fuel delivery is ensured.

Inlet supply pressure of brake system

5.5 ... 8.3 bar gauge pressure (100 ± 20 psi)

Reversible servovalve max. discharge pressure at manifold pressure of 0: 1.9 ... 2.0 bar gauge pressure (28 ... 29 psi)

Regulating pressure
0 to max. intake-manifold pressure

Air-cylinder bore
19.05 mm (3/4").

The reversible servovalve is set such that with a supply pressure of 6.9 bar gauge pressure the following pressure conditions prevail:

Signal pressure	Discharge pressure
0	1.9
0.35	1.6 ... 1.7
1.9	0

The air cylinder is attached to the pump, for control-rod guidance, by means of a fitting instead of the closure cap. The piston in the cylinder is in contact with the control rod when the air cylinder is subjected to compressed air.

Maintenance

The MPL requires no maintenance. The reversible servovalve has been preset and lead-sealed. Subsequent setting is therefore not possible. Operation of the air cylinder can be determined by ear and by touch.

Testing the air cylinder

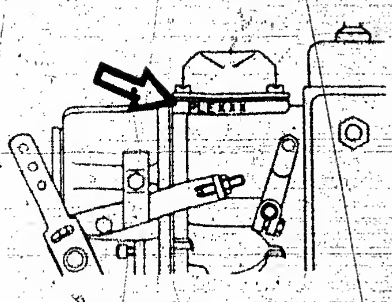
This test should only be performed by a MACK dealer.

Removal of air cylinder

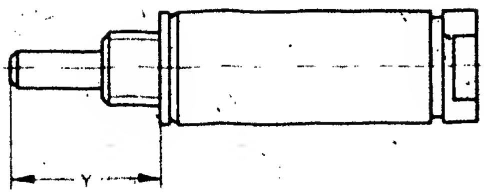
The air cylinder is secured with LOCTITE and has no flats for fitting a wrench. It must be removed carefully to prevent damage.

Fitting the air cylinder, PLE dimension

The PLE dimension (PLE = Puff-Limiter-Extension) is stamped, in inches, on the left side of the governor on the shoulder below the closure cap. E.g. 1.037" (1" = 25.40 mm).



Subject the removed air cylinder with at least 4.1 bar and measure dimension "Y" of the cylinder. Dimension "Y" is the distance between the contact surface of the cylinder at the threaded end and the tip of the extended piston rod. Subtract the PLE-dimension from "Y" and select shims approximating to the result obtained (± 0.1 mm).



Example: PLE-dimension 1.037" x 25.4 = 26.3 mm

Y		29.6 mm
PLE-dim.	=	26.3 mm
Diff.	=	3.3 mm

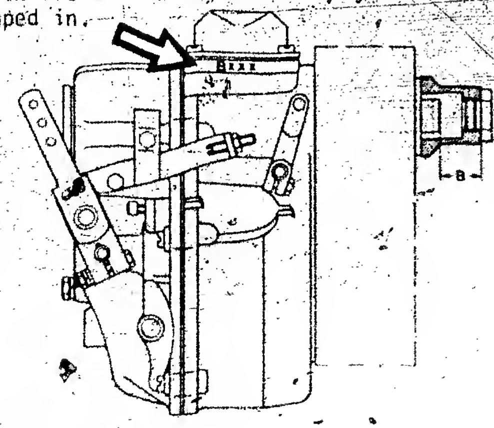
Offset the difference using shims.
Suitable shims may be obtained from MACK dealers.
Slip the shims over the external thread of the air cylinder and screw the cylinder into the threaded fitting, leaving approx. 3 mm of thread exposed. Add a drop of LOCTITE to the exposed threads.
Tighten the air cylinder by hand.
Connect the pressure line of the reversible servovalve to the air cylinder.

Troubleshooting

Problem	Possible cause	Remedy
Engine fails to start or starts with difficulty	Air cylinder preventing full starting fuel-delivery from pump.	Check parking brake system. It must be actuated prior to starting. Check all lines of manifold-pressure compensator system for leaks. Check operation of air cylinder. Check operation of reversible servo-valve.
Excessive smoke during acceleration.	Fractured pipe to air cylinder	Check and replace fractured or poor air pipes.
	Clogged or fractured signal pressure pipe	
	Air cylinder not operating	Check air cylinder, replace if necessary.
	Air cylinder wrongly adjusted	Remove air cylinder. Check operation and PLE-dimension. Fit air cylinder using correct shims.
Poor performance	Air cylinder wrongly adjusted	Check air cylinder, replace if necessary.
	Air cylinder sticks in puff limiting position	Check air cylinder, replace if necessary.
	Defective reversible servovalve permitting too much compressed air to air cylinder.	Check air pressure at outlet of reversible servovalve. Replace servovalve if tolerance is not complied with.

B-dimension check

The B-dimension is designed for static checking of the control-rod travel. It is used when the air cylinder is not fitted, i.e. the engine is not fitted with the MPL. Dimension "B" can also be used to ascertain whether the governor has been tampered with.
Remove the closure cap for the control rod. Move the control rod to full-load (21 mm control-rod travel) and lock. Bring the control lever to stop several times and release. The blade of the rocker should contact the rocker guide of the full-load stop.
Measure dimension B as per diagram. Check the dimension obtained by reactivating the stop lever, marking a new dimension on the shoulder under the closure cap on the left side of the governor should there be any deviation from the dimension already stamped in.



Torque limiter

The MPL is connected with the torque limiter, which is available for various transmissions. The torque limiter consists of the control valve on the transmission, special reducing fittings and connecting pipes. The control valve in this device operates as a discharge valve.

If the reverse gear is selected in the case of transmission TRXL 107, or reverse gear and crawler (Lo-Lo) gear with the transmission TRXL 1071, the control valve opens and the intake-manifold pressure reaches the torque limiter via the connecting pipe. As a result, the reversible servovalve delivers the maximum discharge pressure and in this manner the air cylinder can limit the torque accordingly.

The special fitting is so designed that discharge to the reversible servovalve occurs if there is an excessive amount of air. This gives rise to a condition similar to the normal operating condition.

Reduced-delivery stop

Due to the roughly 50% increase in torque, this engine delivers the same output at a speed of 1200 ... 2100 min^{-1}. Since optimum fuel economy is achieved at a speed of 1800 min^{-1}, the speed can be limited in the top 2 gears of the 7-speed transmission. In the bottom 5 gears, the higher speed is required for acceleration.

The air cylinder is attached to the governor cover by means of a stop strip. Together with an adjustable stop mounted on the control-lever shaft, the control-lever travel can be limited by the air cylinder. If the air cylinder is subjected to compr. air, the full speed of 2100 min^{-1} is achieved. The transmission linkage is connected with a pneumatic valve and controls the air cylinder. At zero air pressure the air-cylinder piston is at its maximum extension and limits the speed to 1800 min^{-1}.

Adjustment of governor on the test bench

Two breakaways have to be adjusted
a) 1050 min^{-1} without air cylinder fitted.
b) 900 min^{-1} with air cylinder fitted and delivery stop on control-lever shaft. Drive the test bench at a speed of 900 min^{-1} (without compressed air in cylinder). Adjust the reduced-delivery stop for a breakaway of 940 ... 950 min^{-1} (control rod travel 1 mm less than at full load and 900 min^{-1}).

DYNATARD exhaust brake

With this device, the intake valves of the engine operate normally, the timing being the same as in a 4-stroke engine. The exhaust valves have two timing modes depending upon whether DYNATARD is switched on or off. DYNATARD can only be operated when the control rod is in the stop position and there is no injection. Only then is the circuit closed via a grounding contact in the governor cover.

Solenoid-operated valves (1 in each rocker arm shaft) shut off the engine oil flow to the hydraulic part of the exhaust-valve rocker arm and cause a brief "idle" stroke. This causes the exhaust valves to open shortly before the completion of the compression stroke which is not followed by a power stroke because there is no injection.

The grounding contact is not included in the scope of delivery, and is retrofitted in the closing cover pos'n 109 in the service parts list. It is not a Bosch part and is available only from a MACK dealer. The contact has been preadjusted, and does not normally require any adjustment.

If however, the grounding contact does require adjustment for any particular reason, proceed as follows: Run the engine in idle at a speed of 550 min^{-1}. Release the locking nuts on the grounding contact. Unscrew the setting screw until the DYN switches on. Now screw the setting screw one complete turn back in again. Tighten the locking nuts. The plug must point upwards.
Check whether the DYN switches in at a speed of 700 ... 1000 min^{-1}.

4. Supply pump

The fuel-injection pumps listed in Section 1 are not delivered with Bosch supply pumps. Fuel supply is by means of a combination comprising supply pump and tachometer drive fitted in a housing. The combination is driven by the engine. It is manufactured by the VIKING company.

The supply pump is a gear pump. It is driven directly and runs at half engine speed. The overflow valve opens at 4.1 ... 4.8 bar. The supply pump is sealed off to the outside by means of O-rings and radial seals.

If starting problems occur, or the engine runs unevenly, the supply pump and fuel lines are to be checked for leaks. Only after this has been done is the injection-pump assembly to be removed if necessary.

Simple tests

Delivery:

Unscrew the hose (pressure side) from the supply pump to the filter at the filter. Hold the hose fitting (higher than the supply-pump fitting) in a container. Start the engine. There must be a strong flow of fuel.

Leaks on upper seal rings:

Unscrew the flexible drive shaft for the tachometer from the supply pump. Fill the vacant opening on the supply pump with engine oil up to the rim. Start the engine. If the oil overflows, the supply pump is defective and must be replaced.

5. Fitting the fuel-injection pump

Coat the camshaft thread with LOCTITE 262 and tighten the hexagon nut with 170 ... 180 Nm (17 ... 18 kgfm). Turn the engine over in its normal direction of rotation until cylinder 1 is at the compression stroke and the timing marks on the vibration damper and/or on the flywheel indicate the correct number of degrees for the adjustment. The appropriate data is given on a plate on the valve cover.
The dogs on the drive coupling must now be horizontal, and the bore of the marker pin in the 4 o'clock position.

Grease the front of the drive coupling (not counterbored), mount the drive flange and center the coupling ring laterally.

Rotate the pump on the driven flange until the dogs are vertical and the marking bore is in the 7 o'clock position.

Mount the injection-pump assembly on the engine. While the pump is being correctly positioned, observe the marker pin.

Mount the intermediate flange on the cylinder block. Tighten the screws lightly.

Tighten the screws (3/8" = approx. 9.5 mm dia.) which join the two halves of the console. Tighten the lower locking screws, thus aligning the two halves of the console. Release the 3/8" screws again.

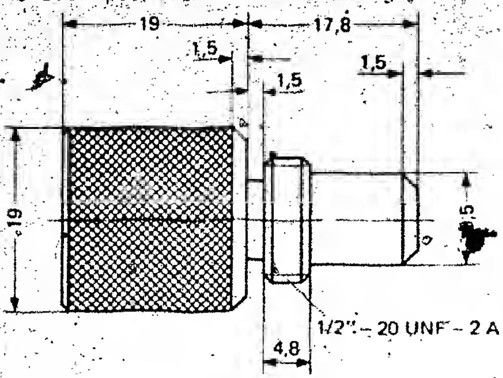
Tighten the intermediate flange on the cylinder block. Tighten the 3/8" connecting screws.

Check through the inspection port whether approx. 2.4 mm are exposed at the end of the coupling ring.

Turn the engine over in its normal direction of rotation until the 1st cylinder is once more at compression stroke and the adjusting marks on the flywheel and/or vibration damper become visible, as specified on the plate on the valve cover.

6. Timing the injection pump to the engine.

Connect high-pressure hand supply pump 1 687 222 048 and set port closing in the usual manner. To set the port closing it is necessary to locally manufacture a gauge according to the sketch below, or to use some other suitable device to prevent the control rod from being in the STOP position and thus wrongly set.



The gauge above is not required when an air cylinder is fitted for MPL or torque limiter. It then suffices for the air cylinder to be subjected to compressed air (at least 2.0 bar) and the pressure to be maintained during the adjustment.

7. Bleeding the fuel system.

Due to the fact that a hand pump is not fitted to the supply pump, the usual bleeding methods cannot be employed.

Example 1:

Using locally made fittings, connect either the Bosch hand pump 0 440 011 006 for instance or the electric fuel pump 0 580 .. between the fuel tank and the 1st fuel filter. Tighten all the lines in the fuel system. Release the overflow valve on the injection pump. Operate the hand pump, or the electric fuel pump, until fuel issues without bubbles.

Example 2:

First tighten all the lines in the fuel system. Release the overflow valve on the injection pump. Wrap a clean cloth around the compressed-air pistol, press the pistol up tightly against the fuel-tank filler neck and blow compressed air into the system. The pressure in the workshops compressed-air system is usually sufficient to force fuel from the tank to the injection pump. The fuel must issue from the overflow valve bubble-free.

8. Technical documentation

Equipment lists on microfiches AC

Testing instructions for governor VDT-W-420/303 En Ed. 2

Testing instructions for hole-type nozzles VDT-W-433/301

Testing instructions for nozzle-and-holder assemblies VDT-W-432/300 En

Lubrication instructions for fuel-injection equipment VDT-W-Gen./6

Test specifications on microfiches

Service parts lists on microfiches

Technical bulletin VDT-I-410/102 En Modification PE/S)..P..A

Technical bulletin VDT-I-410/1000 En
Tappet holder KDEP 1041 for P-pumps.

Technical bulletin VDT-I-420/105 En
Modification to the governor assy.

Technical bulletin VDT-I-420/107 En
Modified spring seat.

Technical bulletin VDT-I-420/109 En
New fastening to edge cam and locating pin in the governor cover.

Technical bulletin VDT-I-420/1000 En
Clamping device KDEP 2894, modification to the clamping nut.

9. Warranty

Warranty claims for damage to Bosch fuel-injection pumps caused by MACK auxiliary units are to be settled with MACK TRUCKS INC. through a MACK dealership.
Claims for damage caused to Bosch equipment as a result of material or production defects in this equipment are to be settled in the customary manner during the warranty period.
As is the case for other commercial-vehicle manufacturers, the warranty period for Bosch products is 12 months or a maximum of 50,000 km.

MAN/BÜSSING COMMERCIAL VEHICLES
Fuel-injection pumps:
Replacement of Schäfer pumps by Bosch pumps.

VDT-I-MAN 006 En
9.1978

Fuel-injection pumps from the now extinct firms of Kugelfischer or Schäfer-Einspritztechnik were produced up to the end of 1974. It is to be expected that service parts will cease to be available within the next few years.

Large-scale repairs of Schäfer diesel fuel-injection pumps are no longer to be carried out. We recommend that an appropriate Bosch injection-pump assembly be fitted instead.

In the cross-reference given on the other side of this sheet, Schäfer injection pumps from MAN and BÜSSING engines are listed together with the appropriate Bosch fuel-injection pump assembly with which they can be replaced.

Port-closing table

Before the Bosch replacement pump is fitted, details must always be obtained from a MAN representative regarding the appropriate (FB) port closing for the engine type and the injection pump in question.

Engine type	FB Bosch	FB Schäfer
0846 HMXN	26° ± 1°	57° ± 1°
0846 HMYN	26° ± 1°	57° ± 1°
0026 M.1/6	34° ± 1°	39° ± 1°
2156 HMX	24° ± 1°	57° ± 1°
2156 HMXN	24° ± 1°	57° ± 1°
2156 MTX	25° ± 1°	64° ± 1°
2156 MTXN	25° ± 1°	64° ± 1°
2156 MY	27° ± 1°	37° ± 1°
2156 MYN	27° ± 1°	37° ± 1°
2356 HMX	27° ± 1°	64° ± 1°
2356 HMXN	27° ± 1°	64° ± 1°

Notes on after-sales service

The fuel-injection pump assemblies listed on the reverse of this sheet are identical with one another as regards fitting and function. On certain engines, a different port closing must be set according to the above table. The fuel-injection lines are to be replaced, and can be obtained singly, or in sets, together with necessary screws, clips and rubber washers etc. from a MAN representative.

BOSCH Geschäftsbereich KH, Kundendienst, Kfz-Ausrüstung
© by Robert Bosch GmbH, D-7 Stuttgart 1, Postfach 50 Printed in the Federal Republic of Germany
Imprimé en République Fédérale d'Allemagne par Robert Bosch GmbH

Engine type	Schäfer designation	Bosch part no.	MAN-No. 51.111.01..
MAN			
2156 HM 3 2156 HM 9 2156 HMN 1 2156 HMX N 2156 HMX 2146 HM 23	PSAF 16-07.101 A 2 to 5 PSAF 16-07.101 A 5 RV 1 and A 6 RV 1	0 400 846 189 0 400 846 338	7283 –
2356 HM 4 2356 HM 9 2356 HMXN 2356 HMX 2356 HMN 4	PSAF 16-07.102 A 1 to 4 PSAF 16-07.102 A 4 RV 1 and A 5 RV 1	0 400 846 191 0 400 846 337	7351 –
0836 HM 73 A 0836 HM 74 A 0836 HM 7 H 0836 HMN 70 0836 HM 91 H	PSAF 16-07.103 B 2 PSAF 16-07.103 B 2 RV 1	0 400 846 334 0 400 846 404	7652 –
2146 M 9 2146 M 12 2146 M 14 2146 MN 11 2156 MX	PSAF 16-07.105 A 1 to 3 PSAF 16-07.105 A 4 RV 1	0 400 846 087 –	7348 –
2156 MTN 1 2156 MTXN 2156 MT 2 2156 MTX	PSAF 16-07.109 A 1 to 3 PSAF 16-07.109 A 4 RV 1	0 400 846 230 0 400 846 411	7426 –
0846 HMN 1 0846 HMXN 0846 HMYN	PSAF 16-07.110 A 1 PSAF 16-07.110 A 1 RV 1	0 400 846 334 0 400 846 332	7652 –
2156 MY 2156 MYN	PSAF 16-07.111 A 1 PSAF 16-07.111 A 1 RV 1	0 400 846 087 –	7348 –
0026 M 6	PSA 16-07.202 A 6	0 400 256 078	7205
BÜSSING			
U 11 D	PSAE 16-09.22 A 3 PSA 16-09.22 A 1 to 3	0 401 046 001 0 401 046 001	– –
U 7 D	PSAE 16-09.23 D 1 PSA 16-09.23 D 1	0 400 656 102 0 400 656 102	– –
U 12 D	PSAE 16-09.24 B 2 PSAE 16-09 21 C 1	0 401 056 009 0 401 056 009	–

This information is available only in German. If necessary, please contact your regional representative.

Cette information n'est disponible qu'en allemand. Le cas échéant, veuillez vous adresser à votre représentation régionale.

Esta información está disponible únicamente en alemán. En caso necesario, sírvase dirigirse a su Representación Regional.

Questa informazione è disponibile solo in lingua tedesca. Se necessario, rivolgersi al proprio rappresentante di zona.

This information is available only in German.
If necessary, please contact your regional representative.

Cette information n'est disponible qu'en allemand. Le cas échéant, veuillez vous adresser à votre représentation régionale.

Esta información está disponible únicamente en alemán. En caso necesario, sírvase dirigirse a su Representación Regional.

Questa informazione è disponibile solo in lingua tedesca. Se necessario, rivolgersi al proprio rappresentante di zona.

A28

MAN - Engine V 8 D 2538 M, . . MF, . . MR, . . MFR

VDT-I-MAN 007 En
11.1979

Interchangeability of injection pumps SIGMA - Bosch

MAN has equipped the above mentioned engines with SIGMA Injection pumps. In the case of extensive repair to a SIGMA injection pump, a corresponding Bosch injection pump assembly can be fitted.

The following is a cross-reference list of the SIGMA injection equipment and the interchangeable Bosch injection equipment.
When using the Bosch injection assemblies the nozzle-and-holder assembly, the pressure lines etc. must be changed. In addition a few conversion parts are necessary.

1. Injection equipment

	SIGMA designation	Bosch part no.
Injection pump	CMSM 8 D 90 TBL 7504-1	0 400 648 075
Nozzle-and-holder assembly	DEO. 40 A1/DK 45	0 432 231 868
consisting of:		
Nozzle-holder assembly	DEO. 40 A1	0 430 233 003
Nozzle	DK 45	0 433 271 285 Nozzle 0 433 271 285 may only be fitted when the complete Bosch injection equipment is used.
Injection pump	CMSM 8 D 90 TBL 7504-2	0 400 648 075
	CMSM 8 D 80 TBL 7504-3	0 400 648 075
Nozzle-and-holder assembly	DEO. 40 A1/DK 46	0 432 231 868
consisting of:		
Nozzle-holder assembly	DEO. 40 A1	0 430 233 003
Nozzle	DK 46	0 433 271 285

BOSCH
Geschaftsbereich KH Kundendienst Kfz-Ausrüstung
© by Robert Bosch GmbH, D-7 Stuttgart 1, Postfach 50. Printed in the Federal Republic of Germany.
Imprimé en République Fédérale d'Allemagne par Robert Bosch GmbH

B1

2. Pressure lines for Bosch injection equipment

Cylinder 1 to 4 MAN No. 51.10301-6116

Cylinder 5 to 8 MAN No. 51.10301-6117

3. Conversion parts

Amount	Designation	DIN designation		MAN no.
General				
2	Fillister-head screw	M10 x 25	DIN 6912 10.9	
2	Spring washer	B10	DIN 137	
2	Hexagon screw	M8 x 60	DIN 931 10.9	
1	Hexagon screw	M10 x 85	DIN 931 10.9	
1	Hexagon screw	M10 x 115	DIN 931 10.9	
2	Spherical washer	C8.4	DIN 6319	
2	Spherical washer	C10.5	DIN 6319	
1	Intermediate piece			51.11403-0018
1	Branch piece			51.98130-0077
1	Fuel line from filter to injection pump			X51.12301.5440
1	Fuel line from supply pump to filter			X51.12301.5442
1	Fuel line from injection pump to multiple inlet union			See MAN-ET catalog
D 2538 M				
1	Governor arm			51.11605-5040
1	Fuel line from injection pump to solenoid valve			51.12301-5364
D 2538 MF				
1	Governor arm			51.11605-5049
1	Fuel line from injection pump to solenoid valve			51.12301-5364
D 2538 MR				
1	Governor arm			51.11605.5040
1	Fuel line from injection pump to solenoid valve			51.12301-5377
D 2538 MFR				
1	Governor arm			51.11605-5049
1	Fuel line from injection pump to solenoid valve			51.12301-5377

4. Start of delivery

For Bosch injection pump equipment the start of delivery (FB) should be adjusted to: 24° ± 1° BTDC.

B2

This information is available only in German. If necessary, please contact your regional representative.

Cette information n'est disponible qu'en allemand. Le cas échéant, veuillez vous adresser à votre représentation régionale.

Esta información está disponible únicamente en alemán. En caso necesario, sírvase dirigirse a su Representación Regional.

Questa informazione è disponibile solo in lingua tedesca. Se necessario, rivolgersi al proprio rappresentante di zona.

B3

Interchangeability of injection pumps SIGMA - Bosch

MAN has equipped the above mentioned engines with SIGMA injection pumps. In the case of extensive repair to a SIGMA injection pump, a corresponding Bosch injection pump assembly can be fitted.

The following is a cross-reference list of the SIGMA injection equipment and the interchangeable Bosch Injection equipment.
When using the Bosch injection assemblies the nozzle-and-holder assembly, the pressure lines etc. must be changed. In addition a few conversion parts are necessary.

1. Injection equipment

	SIGMA designation	Bosch part no.
Injection pump	CMSM 10 D 90 TBL 7506-1	0 400 649 156
Nozzle-and-holder assembly	DEO. 40 A 1/DK 45	0 432 231 868
consisting of:		
Nozzle-holder assembly	DEO. 40 A 1	0 430 233 003
Nozzle	DK 45	0 433 271 285
		Nozzle 0 433 271 285 may only be fitted when the complete Bosch injection equipment is used.
Injection pump	CMSM 10 D 90 TBL 7506-2	0 400 649 156
	CMSM 10 D 80 TBL 7506-3	0 400 649 156
Nozzle-and-holder assembly	DEO. 40 A 1/DK 46	0 432 231 868
consisting of:		
Nozzle-holder assembly	DEO. 40 A 1	0 430 233 003
Nozzle	DK 46	0 433 271 285

BOSCH Geschäftsbereich KH Kundendienst Kfz-Ausrüstung
© by Robert Bosch GmbH, D-7 Stuttgart 1, Postfach 50. Printed in the Federal Republic of Germany.
Imprimé en République Fédérale d'Allemagne par Robert Bosch GmbH.

B4

2. Pressure lines for Bosch injection equipment

Cylinder 1 to 5 — MAN No. 51.10301-6114
Cylinder 6 to 10 — MAN No. 51.10301-6115

3. Conversion parts

Amount	Designation	DIN designation		MAN No.
General				
2	Fillister -head screw	M10 x 25	DIN 6912 10.9	
2	Spring washer	B10	DIN 137	
2	Hexagon screw	M8 x 60	DIN 931 10.9	
1	Hexagon screw	M10 x 85	DIN 931 10.9	
1	Hexagon screw	M10 x 115	DIN 931 10.9	
2	Spherical washer	C8.4	DIN 6319	
2	Spherical washer	C10.5	DIN 6319	
1	Intermediate piece			51.11403-0018
1	Generator arm			51.11605-5049
1	Fuel line from supply pump to filter			X51.12301-5444
1	Fuel line from filter to injection pump			X51.12301-5440
1	Fuel line from injection pump to multiple inlet union			See MAN-ET catalog
1	Branch piece			51.98130-0077
D 2530 MF				
1	Fuel line from injection pump to solenoid valve			51.12301-5365
D 2530 MFR				
1	Fuel line from injection pump to solenoid valve			51.12301-5378

4. Start of delivery

For Bosch injection pump equipment the start of delivery (FB) should be adjusted to:

24° ± 1° BTDC.

MAN - Engines D 2555 M,..MF,.. MX,.. MXF
D 2556 M,..MF,.. MX,.. MXF

VDT-I-MAN 009 En
11.1979

Interchangeability of injection pumps SIGMA - Bosch

MAN has equipped the above mentioned engines with SIGMA injection pumps. In the case of extensive repair to a SIGMA injection pump, a corresponding Bosch injection pump assembly can be fitted.

The following is a cross-reference list of the SIGMA injection equipment and the interchangeable Bosch injection equipment.
When using the Bosch injection assemblies the nozzle-and-holder assembly, the pressure lines and flame starting lines must be changed.

1. Injection pumps

Engine type output	SIGMA designation	Bosch part no.	MAN No. 51.111 01-
D 2555 M,..MF 124 kW (162 HP)	CMSM 5 D.. 7507-2	0 400 845 021	7528
D 2555 MX,.. MXF 141 kW (192 HP)	CMSM 5 D.. 7507-1	0 400 845 012	7618
D 2556 M,.. MF 141 kW (192 HP)	CMSM 6 D.. 7500-2	0 400 846 346	7529
D 2556 MX,.. MXF 176 kW (240 HP)	CMSM 6 D.. 7500-1	0 400 846 307	7598

2. Nozzle-holder assemblies and nozzles for all engine types

	SIGMA designation	Bosch part no.
Nozzle-and-holder assembly	DEO. 40 A 1/DK 47	0 432 231 864
consisting of:		
Nozzle-holder assembly	DEO. 40 A 1	0 430 233 003
Nozzle	DK 47	0 433 271 306

BOSCH Geschäftsbereich KH Kundendienst Kfz-Ausrüstung
© by Robert Bosch GmbH, D-7 Stuttgart 1, Postfach 50 Printed in the Federal Republic of Germany
Imprimé en République Fédérale d'Allemagne par Robert Bosch GmbH

3. Pressure and flame starting lines

Engine type	SIGMA injection assembly		Bosch injection assembly	
	Pressure line	Flame starting line	Pressure line	Flame starting line
	MAN no. 51.10302-	MAN no. 51.12301-	MAN no. 51.10301-	MAN no. 51.12301-
D 2555 M	6012	5336	6120	5318
D 2555 MF	6013	5337	6118	5321
D 2555 MX	6007	5336	6005	5318
D 2555 MXF	6008	5337	6006	5321
D 2556 M	6014	5336	6121	5318
D 2556 MF	6015	5337	6119	5321
D 2556 MX	6001	5336	6126	5318
D 2556 MXF	6002	5337	6127	5321

4. Start of delivery

For Bosch injection pump equipment the start of delivery (FB) should be adjusted to:

26° ± 1° BTDC.

Commercial vehicle types 6.90, 8.90, 8.136, 9.136 with VE..F..distributor-type fuel-injection pump

1.1980

Types 6.90 and 8.90 are being delivered with 4-cylinder engine D 0224 M and ..MF, types 8.136 and 9.136 with 6-cylinder engine D 0226 M and ..MF. With these water-cooled 4-stroke engines with direct fuel-injection the VE..F..distributor-type fuel-injection pump is fitted with part-load governor or variable-speed governor, electromagnetic shutoff device and overflow valve for flame starting systems.

Engine data

	D 0224	D 0226
Engine swept volume	3800 cm^3	5700 cm^3
Output	66 kW (90 HP)	100 kW (136 HP)
Rated engine speed	3000 min^{-1}	3000 min^{-1}
Ignition sequence	1-3-4-2	1-5-3-6-2-4
Compression	17.5 : 1	17.5 : 1

Fuel-injection equipment

Engine	Distributor-type fuel-injection pump	Remarks
D 0224 M	0 460 404 007 - VE 4/10 F 1500 R 42	Part-load governor
D 0224 MF	0 460 404 010 - VE 4/10 F 1500 R 57	Variable-speed governor
D 0226 M	0 460 416 008 - VE 6/11 F 1500 R 49	Part-load governor
D 0226 MF	0 460 416 009 - VE 6/11 F 1500 R 55	Variable-speed governor

Fuel filter

Single-stage box-type filter	0 450 133 016 - FJ/DBR 1 W 6/7	
Two-stage box-type filter	0 450 134 018 - FJ/DBRR 2 W 6 W 6/9	for special use
Fuel-filter box	1 457 434 093	for both filter types

Nozzle-holder assembly

Nozzle-and-holder assembly consisting of:	0 432 231 820
Nozzle-holder assembly	0 430 233 994 - KDEL 82 S 7/13
Nozzle	0 433 271 413 - DLLA 35 S 812
Opening pressure	175 + 8 bar gauge pressure

BOSCH
Geschäftsbereich KH Kundendienst Kfz-Ausrüstung
by Robert Bosch GmbH D-7 Stuttgart 1 Postfach 50 Printed in the Federal Republic of Germany
Imprimé en République Fédérale d'Allemagne par Robert Bosch GmbH

Technical documentation

The necessary technical documentation has already been published.
Service parts : on microfiche
Test values : until the microfiche appears provisional values can be obtained, if required, from KH/VSK 1.

Tools

Repairs : Catalog sheet KD-EP 11 En and 12 En of 10.1979
Testing : Timing-device-travel measuring device 1 688 130 139

Exchange pumps

The distributor-type fuel-injection pumps have been included in the exchange program with index 090.

Timing the pump to the engine

The timing of this distributor-type fuel-injection pump is carried out according to the dial-indicator method.

Timing point
Pump : at a plunger lift of 1.0 mm after BDC
Engine : 11° BTDC

Work units

Work units for repairs and testing have not yet been published.

Provisional work units:

Complete dismantling	35 AW
Checking, adjusting and eliminating minor faults (e.g. leakage)	16 AW

After-sales service note

After-sales service will be carried out in the usual manner on this distributor-type fuel-injection pump. Please contact the MAN representative in your area in order to find out the sales figures for these vehicles.
Please see that faultless and speedy after-sales service work is carried out on the fuel-injection systems of these vehicles in your workshop.

B9

Register tab 6 Vehicles
File
Identity VDT-I-MAN 011 En

4.1986

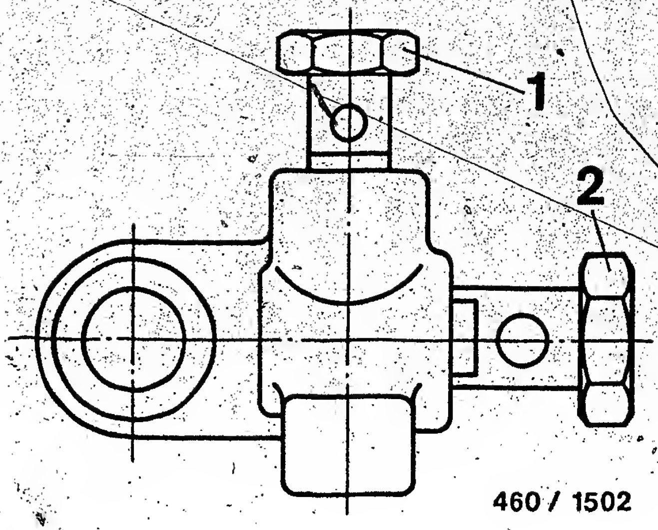
COMMERCIAL-VEHICLE ENGINES
D 0224.. AND D 0226..
WITH DISTRIBUTOR-TYPE PUMP

Starting problems at low temperatures

The commercial vehicles with engines of series D 022.. are equipped with a flame-starting system. Through an overflow valve a specific quantity of fuel is supplied to the flame-starting plug where it ignites during starting. Poor starting occurs if the flame-starting quantity is too small, or if the flame formed in the intake manifold is too weak.

The cause of a weak flame or of insufficient fuel quantity may be that the overflow valve is set too low. The opening pressure is factory-adjusted with a special device at a flow rate of 180 cm^3/min. <u>Without this device it is not possible to perform an inspection at BOSCH or MAN service centers.</u> In the case of complaints, therefore, replace the entire overflow valve with date of manufacture before 543.

As of date of manufacture 544, the opening pressure and the flow rate have been correspondingly adapted. Stocks should likewise be checked, and warranty reports should be sent with reference to this Service Information.



<u>Overflow valve</u>: 1 = Hollow screw
2 = Overflow valve

<u>Warranty procedure inside Germany</u>
Send overflow valves with date of manufacture before 543 with warranty report G20 and delivery slip KH/VKD3-- 15 333 to
ROBERT BOSCH GMBH K5/QSG, Wareneingang,
Am Boschwerk, 7000 Stuttgart 30

<u>Warranty procedure outside Germany</u>
Overflow valves with date of manufacture before 543 are discarded by RG/AV and are accounted with warranty report G21.

The part numbers of the overflow valves used can be seen from the following list:

Part no.:	MAN no.:	Oveflow valve:
0 460 404 010	51.11102-7244	1 467 413 303
... 014	-7130	"
... 015	-7125	"
... 016	-7126	"
... 017	-7127	"
... 030	-7329	"
... 416 009	-7245	"
... 016	-7137	"
... 017	-7128	"
... 018	-7129	"
... 019	-7130	"
... 024	-7507	"
... 028	-7516	"
... 037	-7517	"
... 037	-7531	"
... 062	-7643	"
... 426 033	-7461	"
... 065	-7604	"
0 460 426 028	51.11102-7516	1 467 413 004
... 030	-7332	"
... 031	-7350	"
... 034	-7474	"
... 032	-7515	"
... 036	-7518	"

Published by:

ROBERT BOSCH GMBH
Division KH
Technical After-Sales Service (KH/VKD 2)

Please direct questions and comments concerning the contents to our authorized representative in your country.

Register tab 6 .Vehicles
File Identity VDT-I-MAN 012 En

MAN COMMERCIAL VEHICLES

12.192, 14.192, 16.192
with engine D 0 226 MK

4.1986

Hot-starting problems

With the engine warm, there may be starting problems with the above-quoted vehicles that are equipped with distributor-type pump VE 6/12 F 1400 R 120 (0 460 426 028). After cranking, the engine either fails to start or dies again after a short time. The cause is insufficient inner sealing of the central screw plug (Item 130 in service-parts list).

Corrective action:
The complaint is remedied by replacing the central screw plug. The plug is tightened to 80 Nm with the aid of service tool KDEP 1080.

During the warranty period, please report your expenditures through the usual channels with warranty report. Out of warranty, this work is subject to payment.

Published by:

ROBERT BOSCH GMBH
Division KH
Technical After-Sales Service (KH/VKD 2)

Please direct questions and comments concerning the contents to our authorized representative in your country.

SERVICE INFORMATION >===<

Fuel-injection equipment

MERCEDES-BENZ OMNIBUS VDT-I-MB 042 En

Engine OM 422 A with 243 kW (330 HP) 11.1984

M = 1300 Nm

PE 8 P.. pump with RQ..K governor supersedes Edition 8.1981

Some of the above-listed engines may be equipped with pump assemblies having the following designations:

Pump:	PE 8 P 120 A 320 LV 13 191
Governor:	RQ 300/1150 PAV 14 938 K
Supply pump:	FP/K 22 P 44

or

Pump	PE 8 P 120 A 320 LV 13 191
Governor:	RQ 300/1150 PAV 14 362 K
Supply pump:	FP/K 22 P 44

The injection-pump equipment has not been released and is thus not contained on the microfiches. The governor is the new product RQ..K governor (minimum-maximum-speed governor) which is equipped with an additional full-load torque-control device for negative and positive torque control.

Notes on checking pump and governor:

1. Mount injection pump with governor on test bench.
2. Connect all calibrating fuel-injection tubing 1 680 750 067 and calibrating nozzle-and-holder assemblies 1 688 901 019. Connect calibrating-oil inlet and return (overflow valve 1 417 413 025).

B14

3. Mount control-rod-travel measuring device.

4. Mount prestroke measuring device.

5. Measure prestroke and adjust if necessary.

6. Remove prestroke measuring device.

7. Bring governor control lever into full-load position and check in accordance with enclosed test specifications Section A, columns 1 to 4 (note values in parentheses). If these values are not reached, then the constant delivery and basic setting values must be set by re-adjusting at the element flanges. If necessary, check delivery valves, valve springs and delivery-valve holders and, if necessary, replace with new components.

   Caution:
   The full-load stop is a part of the governor and can only be set at the factory or with precise knowledge of the governor.

8. Check setting values of governor (Section B).

   With the governor control lever fully deflected, check values of sliding-block checking (columns 1 and 2) and full-load regulation (columns 3 to 6). If the breakaway speed is incorrect, it is possible to re-adjust at the setting nuts of the flyweight springs as on the normal RQ governor.

   Caution:
   Do not remove the governor cover. If the values of the idle regulation (columns 7 to 10) are not reached, the unit must be sent in to the factory for setting.

The torque control (Section B, columns 11 and 12) and the fuel-delivery characteristics (Section C, columns 4 and 5) cannot be set since they are dependent on the curve of the installed full-load stop. If the required values are incorrect, the unit should likewise be sent in.

9. Check full-load delivery (Section C, columns 1 and 2) as well as starting-fuel delivery (Section C, columns 6 and 7).
   If the required values are not reached, send the pump in for resetting.

10. Remove control-rod-travel measuring device and remove pump from test bench.

After-sales service information:

After-sales service is to be performed as usual in the case of setting errors and in the case of simple mechanical faults on the injection pump (without governor) and the supply pump.

Part numbers for service parts of the injection pump (not for the camshaft) can be taken from the service-parts list of PE 8 P 120 A 320 LS 3807.

The test-specification sheet is in this Service Information on the following page.

In the case of mechanical complaints on pump and governor which you yourself are not able to remedy, send the complete injection-pump unit to the following address:

I-MB042
Seite

Outside Germany: Robert Bosch GmbH
Auspackraum KH/LAV
zur Weiterleitung an
K5 / QSG für K5/VDA
Auf der Breit
D - 7500 Karlsruhe

At the same time, you can send for a replacement pump with part no. 0 401 848 745 from KH/ALP. This pump can be used as a replacement for both types.

Published by:

Robert Bosch GmbH
Division KH
After-Sales Service Department for
Training and Technology (KH/VSK)

Please direct questions and comments concerning the contents to our authorized representative in your country.

B17

Test Specifications Fuel Injection Pumps ② and Governors

Testoil-ISO 4113

En

PE 8 P 120 A 320 LV 13191   RQ 300/1150 PAV 14938 K
Values only apply to test nozzle-and-holder assembly 1 688 901 019 and fuel-injection test tubing 1 680 750 067

supersedes
company: Daimler-Benz
engine: OM 422 A
243 kW (330 PS)
Omnibus

1 - 8 - 7 - 2 - 6 - 3 - 5 - 4 , je 45° ± 0,5° (± 0,75°)

All test specifications are valid for Bosch Fuel Injection Pump Test Benches and Testers

A. Fuel Injection Pump Settings

Port closing at prestroke 4,0-4,1 (3,95-4,15) mm (from BDC) Zyl. 8

Rotational speed rev/min 1	Control rod travel mm 2	Fuel delivery cm³/100 strokes 3	Difference cm³/100 strokes 4	Control rod travel mm 2a	Fuel delivery cm³/100 strokes 3	Spring pretensioning (torque control valve) mm 6
1150	11,1+0,1	15,7-15,9	0,5(0,9)			
300	5,3-5,5	1,4-2,3	0,8(1,2)			
775	10,7+0,3	C. Sp. 4 u. 5				
600	10,5+0,3					
500	10,4+0,3					

Adjust the fuel delivery from each outlet according to the values in

B. Governor Settings

Checking of slider PRG check ① rev/min 1	Control rod travel mm 2	Full-load speed regulation: Setting point rev/min 3	Control rod travel mm 4	Test specifications ④ Control rod travel mm 5	rev/min 6	Idle speed regulation: Setting point rev/min 7	Control rod travel mm 8	Test specifications ⑤ rev/min 9	Control rod travel mm 10	Torque control ③ rev/min 11	Control rod travel mm 12
600	15,0-16,0	600	15,5	10,2	1190-1205	300	5,1	100	min. 6,7	1150	10,9-11,2
				4,0	1260-1295			300	5,0-5,2	755	10,7-11,0
										600	10,5-10,8
VH ca. 52°				VH ca. 49°				360-410	= 2,0 mm	500	10,4-10,7

Torque control travel on flyweight assembly dimension a = mm   Speed regulation: At 1190 - 1205 min   1 mm less control rod travel

C. Settings for Fuel Injection Pump with Fitted Governor

Full-load delivery on governor control lever, Test oil temp. 40°C (104°F) ② rev/min 1	cm³/1000 strokes 2	Control rod stop ③a rev/min 3	Fuel delivery characteristics ③b rev/min 4	cm³/1000 strokes 5	Starting fuel delivery Idle speed ⑥ rev/min 6	cm³/1000 strokes / Control rod travel mm 7
1150	157,0-159,0 (154,0-162,0)	-	775	160,0-166,0 (157,0-169,0)	100	115,0-135,0
			600	148,0-154,0 (145,0-157,0)		
			500	134,0-140,0 (131,0-143,0)		

Checking values in brackets

9.84

1

ENGINE VIBRATION IN UPPER IDLE RANGE	Register tab 6 Motor vehicles
	File Identity VDT-I-MB 043 En
Mercedes-Benz bus O 305	10.1986
Engine OM 407 h	Replaces edition of 05.1982

Injection pumps PES 6 P 100 A 820 LS 264 Z
PES 6 P 100 A 820 LS 351 Z, Y
PES 6 P 110 A 820 LS 442
and generator RQ 300/1100 PA 327
RQ 300/1100 PA 327-1...-7,-9

On this vehicle, after extended running time engine vibration can occur in the upper idle-speed range (approx. 2400 min^{-1} eng.).

A remedial measure in such cases is the conversion of the governor to RQ 300/1100 PAV 17832. This requires removal of the inner governor spring 1 424 616 033 and its replacement with spring 1 424 617 031. This causes the speed droop to rise to approx. 8%.

After conversion, the new governor number must be stamped on the nameplate.

If required, the test specifications for governor RQ 300/1100 PAV 17832 can be obtained from KH/VSK in Wernau. This alteration should be charged to the customer.

Responsible:
ROBERT BOSCH GMBH
Division KH
Technical After-Sales Service (KH/VKD 2)
Please direct questions and comments concerning the contents to our authorized representative in your country.

COMPLAINTS ABOUT LOAD TAKE-UP AT IDLE

VDT-I-MB 044 En
9.1982
(Supersedes ED. 5.1982)

Mercedes-Benz bus 0 305 G
Engine OM 407 hA with
fuel-injection pump PES 6 P 110 A 830 LS 364 and
governor RQ 300/1100 PA 395 R

With this vehicle, there have been some complaints received about a drop in engine speed at low idle speed when loads are switched on.

In such cases, it is possible to obtain an improvement by converting the governor.

The speed droop in the idle range is reduced by modifying the governor to the RQ 300/1100 PAV 15 396 type. The following parts are required:

- 2 x idle springs 1 424 616 021
- 2 x governor springs, inner 1 424 616 034
- 2 x spring seats, upper 2 420 520 004

After conversion, the new governor number must be stamped on the nameplate.

If required, the test specifications for governor RQ 300/1100 PAV 15 396 can be obtained from KH/VSK.

This modification is subject to payment.

Please direct questions and comments concerning the contents to our authorized representative in your country.

BOSCH Geschäftsbereich KH, Kundendienst, Kfz-Ausrüstung
© by Robert Bosch GmbH, D-7 Stuttgart 1, Postfach 50. Printed in the Federal Republic of Germany.
Imprimé en République Fédérale d'Allemagne par Robert Bosch GmbH

B21

1

MERCEDES-BENZ

PASSENGER, OFF-ROAD, AND

COMMERCIAL VEHICLES

Register tab 6 Motor vehicles
File
Identity VDT-I-MB 053 En

10.1986

Diesel knock in part-load range

Replaces edition of 01.1986

If the complaint "diesel knocking" occurs on the above vehicles with the engines:

OM 615: 200 D, 220 D L206 D, -DG, 207 D,
307 D, L405 D, L406 D, LK406 KG

OM 616: 240D, 240 TD, 240 DG, 207 D,
307 D, L407 D, 407 D

OM 617: 240 D 3.0, 300 D, 300 CD, 300 TD,
300 GD, 209 D, 309 D, 409 D

an improvement can be effected by installing wide-angle pintle nozzle DN 0 SD 261 (0 434 250 120).

Nozzle DN 0 SD 261 is also installed in the 190 D (engine OM 601). Replace nozzles in sets. This work is to be charged to the customer.

Responsible:

ROBERT BOSCH GMBH
Division KH
Technical After-Sales Service (KH/VKD 2)

Please direct questions and comments concerning the contents to our authorized representative in your country.

Fuel-injection equipment

VDT-I-MB-054 En

01.1986

MERCEDES-BENZ VEHICLES
AND ENGINES WITH
FUEL-INJECTION PUMP PES..M..

Leaking at spring-chamber closing cover

On the above-quoted fuel-injection pumps there may in individual cases be leaks at the closing cover (Item 111) of the spring chamber.

In the case of complaints about leaking, check the fuel-injection pump for leaks as described in VDT-I-400/109 of 2.1984. If necessary, replace the closing cover with gasket. As an additional measure, lay gaskets of part no. 1 410 121 001 under the fillister-head screws (Item 113) of the closing cover.

As of FD 550, these gaskets are installed as standard equipment. The service-parts lists of the fuel-injection pumps concerned are being extended to include Item 112 - gasket 1 410 121 001.

During the warranty period, claim by warranty report through the usual channels. Outside the warranty period, this work is to be performed subject to payment.

Published by:

ROBERT BOSCH GMBH
Division KH
Technical After-Sales Service (KH/VKD2)

Please direct questions and comments concerning the contents to our authorized representative in your country.

Motor Vehicle Service Information

B22

1

Register tab 6 Vehicles

File Identity VDT-I-MB 055 En

MERCEDES-BENZ ENGINES

OM 422 A and 422 LA

3.1986

Installation of new injection-pump assemblies

Due to a change to the engine camshaft on Mercedes-Benz engines OM 422 A and OM 422 LA, new injection-pump assemblies have been specified for these engines.

1. OM 422 A

Previous injection-pump assemblies:

PE 8 P 120 A 320 LS 3807-10 +
RQ 300/1150 PA 546-3
Assy No. 0 401 848 733 and
PE 8 P 120 A 320 LS 3807-10 +
RQV 300 - 1150 PA 545
Assy No. 0 401 848 732

have been replaced by:

PE 8 P 120 A 320 LS 3807 - 10 +
RQ 300/1150 PA 546-4
Assy No. 0 401 848 760 and
PE 8 P 120 A 320 LS 3807 - 10 +
RQV 300 - 1150 PA 545 - 2
Assy No. 0 401 848 762

2. OM 422 LA:

Previous injection-pump assemblies:

PE 8 P 120 A 320 LS 3807 - 10 +
RQ 300/1150 PA 546 - 2
Assy No. 0 401 848 753 and
PE 8 P 120 A 320 LS 3807 - 10 +
RQV 300 - 1150 PA 545 - 1

have been replaced by:

PE 8 P 120 A 320 LS 3807 - 10 +
RQ 300/1150 PA 546 - 5
Assy No. 0 401 848 761 and
PE 8 P 120 A 320 LS 3807 - 10 +
RQV 300 - 1150 PA 545 - 3
Assy No. 0 401 848 763.

The fuel-delivery settings of the new injection-pump assemblies have been matched to the installation of the changed engine camshaft.

<u>Caution:</u>
On engines of type OM 422 LA, in the transitional phase from engine end no. 109505 to 118563, although changed engine camshafts have been installed, the old-type injection-pump assemblies have been installed.

<u>In this case the old-type injection-pump assemblies that have been installed have been factory-set to the fuel-delivery settings of the new injection-pump assemblies.</u>

The new injection-pump assembly is installed as of engine end number 118564.

<u>Note:</u>

The new injection-pump assemblies must <u>not</u> be installed in engines OM 422 A / LA with <u>old</u> engine camshaft.

This does not affect the start-of-delivery settings.

Published by:

Robert Bosch GmbH
Division KH
After-Sales Service Department
for Training and Technology
(KH/VSK)

Please direct questions and comments concerning the contents to our authorized representative in your country.

Saab-Scania

VDT-I-SCA 003 B

6. 1977

Increased or reduced outputs with engine types D 8, DS 8, D 11, DS 11

Increased or reduced outputs are being readjusted by Saab-Scania in the case of the above-mentioned engines and are marked with an additional letter in the type designation of the fuel-injection pump (cf. SCA 11.0 f, g, h for an example).

The reduced outputs for engine D 11 are contained in test-specification sheet SCA 11.0 n.

Reference will be made in new editions of the appropriate test specification sheets to this Service Information.
Adjustment of the manifold-pressure compensator is no longer required for an output of 85% and less.
The fuel deliveries tabulated were compiled on the basis of documentation and at the request of Saab-Scania.

Engine	Test-specification sheet	Pump	Governor
D 8	SCA 8.0 b 1	PE 6 P 110 A 720 RS 261	RQV . . 170 R, EP/RSV . . 310 R

Pump S . .	Output %	Fuel delivery in cm³/1000 (± 1.0) at a speed of . . min⁻¹				Change in control-rod travel with change in full load
		1200	900	750	600	
X	95	86	84	81	75	– 0.7 mm
Z	90	82	78	74	67	– 1.2 mm
N	85	78	73	67	58	– 1.7 mm
M	80	73	66	60	51	– 2.3 mm
L	75	68	60	55	46	– 2.8 mm
K	70	62	55	49	40	– 3.3 mm
J	65	58	52	47	37	– 3.6 mm
I	60	53	49	44	34	– 3.9 mm

Engine	Test-specification sheet	Pump	Governor
DS 8	SCA 8.0 c	PE 6 P 110 A 720 RS 3012 PE 6 P 110 A 720 RS 3013	RQV . . 275 R EP/RSV . . 310 R
	SCA 8.0 d	PE 6 P 110 A 720 RS 3034 PE 6 P 110 A 720 RS 3035	RQV . . 275 R EP/RSV . . 310 R

Pump S . .	Output %	Fuel delivery in cm³/1000 (± 1.0) at a speed of . . min⁻¹				Change in control-rod travel with change in full load
		1200	900	750	600	
T	103	123	121	121	121	+ 0.3 mm
S	98	115	112	111	110	0.2 mm
X	95	111	108	105	104	0.5 mm
Q	93	108	105	102	100	0.7 mm
Z	90	104	101	97	94	1.0 mm
O	88	102	98	94	89	1.2 mm
N	85	98	95	90	83	1.5 mm
M	80	93	89	83	72	1.9 mm
L	75	88	84	77	63	2.3 mm
K	70	82	77	69	54	2.8 mm
J	65	79	74	66	49	3.1 mm
I	60	75	70	61	44	3.5 mm

BOSCH Geschäftsbereich KH, Kundendienst, Kfz-Ausrüstung.
© by Robert Bosch GmbH, D-7 Stuttgart 1, Postfach 50. Printed in the Federal Republic of Germany.
Imprimé en République Fédérale d'Allemagne par Robert Bosch GmbH.

B25

D3

Engine	Test-specification sheet	Pump	Governor
DS 11	SCA 11.0 m	PE 6 P 110 A 720 RS 3006	RQV . . 242 R
	SCA 11.0 01	PE 6 P 110 A 720 RS 3016	EP/RSV . . 310 R
	SCA 11.0 p	PE 6 P 110 A 720 RS 3014	EP/RSV . . 310 R

Pump S . .	Output %	Fuel delivery in cm³/1000 (± 1.0) at a speed of . . min⁻¹ 1100	900	750	600	Change in control-rod travel with change in full load
P	120	200	205	205	207	+2.1 mm
U	115	190	192	191	195	+1.6 mm
R	113	185	188	187	190	+1.4 mm
W	110	180	181	181	[illegible]	+1.0 mm
V	108	177	178	177	180	+0.8 mm (Case – USA)
Y	105	172	173	172	174	+0.5 mm
T	103	170	170	169	170	+0.3 mm
S	98	160	162	161	162	−0.2 mm
X	95	154	157	156	157	−0.4 mm
Q	93	150	154	153	153	−0.6 mm
Z	90	145	149	149	149	−0.8 mm
O	88	141	145	145	145	−1.0 mm
N	85	135	137	139	138	−1.3 mm
M	80	126	128	130	129	−1.7 mm
L	75	118	118	120	117	−2.1 mm
K	70	110	109	108	105	−2.5 mm
J	65	103	100	99	95	−2.9 mm
I	60	96	93	91	88	−3.4 mm

Engine	Test-specification sheet	Pump	Governor
DS 11	SCA 11.0 i	PE 6 P 100 A 720 RS 202	RQV . . 167 R, 168 R
	SCA 11.0 i1	PE 6 P 100 A 720 RS 203	EP/RSV . . 310 R

Pump S . .	Output %	Fuel delivery in cm³/1000 (± 1.0) at a speed of . . min⁻¹ 1100	900	750	600	Change in control-rod travel with change in full load
W*	110	177	181	183	184	+0.9 mm
V*	108	173	176	178	178	+0.7 mm
Y*	105	169	172	174	173	+0.5 mm
T	103	166	168	170	166	+0.3 mm
S	98	157	159	159	154	−0.2 mm
X	95	152	154	154	149	−0.5 mm
Q	93	148	150	150	145	0.7 mm
Z	90	143	145	144	139	−1.0 mm
O	88	139	141	139	135	1.2 mm
N	85	134	137	134	129	−1.6 mm
M	80	125	127	124	118	2.1 mm
L	75	115	117	113	106	−2.7 mm
K	70	105	107	102	95	−3.2 mm
J	65	98	98	92	85	−3.7 mm
I	60	90	88	82	75	−4.3 mm

* Port closing in these types = 2.4 + 0.1 mm after BDC

D4

C20

SAAB SCANIA — VDT-I-SCA 005 En

Engine models DS 11, DSC 11, DS 14, DSC 14 with fuel-injection pumps PE 6 P.. and PE 8 P..S 7000

07.1984

Supersedes Ed. 12.1983

Complaints about idling

With the above-mentioned engines, complaints may arise with regard to idling. This may be caused by scatter in the fuel-delivery quantities from the injection pump.

Corrective action

If, when the injection pump is checked, a fuel-delivery scatter in excess of 5 cm³/1000 strokes is measured, the calibrating nozzle-holder assembly 1 688 901 019 (perforated plate dia. 0.8 mm), together with its fuel-injection line 1 680 750 015 - 6 x 1.5 x 600 mm, are to be moved from a faulty outlet to another outlet and the test repeated.
If the fault now "shifts" along with the nozzle-holder assembly and the fuel-injection line, this means that the cause of the fault lies in this equipment and not in the injection pump. Corresponding action to check for kinks in the line or for crushed connecting nipples etc. must now be taken.

If, however, the fault remains at the particular outlet this means that the pump is responsible for the fuel-delivery scatter and must be set to the tolerances stipulated in the test-specs sheet.

The adjustments are to be carried out subject to payment.

Please direct questions and comments concerning the contents to our authorized representative in your country.

BOSCH Geschäftsbereich KH, Kundendienst, Kfz-Ausrüstung.
© by Robert Bosch GmbH, D-7 Stuttgart 1, Postfach 50. Printed in the Federal Republic of Germany.
Imprimé en République Fédérale d'Allemagne par Robert Bosch GmbH.

TD 40A engine with VE..F.. distributor-type fuel-injection pump

Since April 1978 Volvo have been using the VE..F.. distributor-type fuel-injection pump with solenoid-operated shutoff device and manifold-pressure compensator (LDA) in the TD 40A engine.

Engine data

6-cylinder 4-stroke diesel engine with whirl chamber, output 88 kW (120 HP), rated engine speed 3600 min^{-1}, engine swept volume 3.59 l, ignition sequence 1-5-3-6-2-4, compression 21:1.

Fuel-injection equipment

Distributor-type fuel-injection pump 0 460 416 001 = VE 6/11 F 1800 L 18

Fuel filters

Single-stage box-type filter 0 450 133 007 - FJ/DBR 1 W 6/225
with water reservoir and drain plug
Fuel-filter box 1 457 434 061

Nozzle-holder assembly

Nozzle-and-holder assembly consisting of:		0 432 297 032
Nozzle-holder assembly	KBE 36 SD 2/13	0 431 211 999
Nozzle	DN 0 SD 193	0 434 250 063
Opening pressure		175 bar gauge pressure

After-sales service instructions

After-sales service will be carried out in the usual manner on these VE..F.. distributor-type fuel-injection pumps. The necessary technical documentation has already been issued.

BOSCH
Geschäftsbereich KH, Kundendienst, Kfz-Ausrüstung.
© by Robert Bosch GmbH, D-7 Stuttgart 1, Postfach 50. Printed in the Federal Republic of Germany.
Imprimé en République Fédérale d'Allemagne par Robert Bosch GmbH.

1. Technical documentation

Information "New product"
VDT-I-460 En, 1 and 2 supplement

Repair instructions
VDT-W-460/100 En and 3 supplement

Test instructions
VDT-W-460/300 En, 1 and 2 supplement

Service parts
Microfiche EP-..

Test values
Microfiche WP-..

Service tools
Catalog sheet KD-EP 9 D (11.77)

Information "Technical bulletin":
LDA with glued bushings VDT-I-460/107 En

2. Tools required for repairing and testing

For repairing these VE..F.. distributor-type fuel-injection pumps the tools listed in Catalog sheet KD-EP 9 D (11.77) are required.

Service tools can be ordered from KH/VKD 4.

The following are required for testing:

Timing-device travel measuring device	1 688 130 139
Intermediate piece M8 x 1 (for adjusting the plunger lift to port closing in connection with the prestroke measuring device 1 688 130 045)	1 683 458 019

Testing with charge air pressure

Adjusting throttle	1 688 130 132
Pressure regulator for compressed air with pressure gauge 0 ... 4 bar	commercially available (e.g. type RM 150, formerly no. 104 from Messrs. Kraiss & Friz, Neckarstr. 182, 7000 Stuttgart 1.
Pressure gauge 0 ... 1.6 bar quality grade 1.0	commercially available (e.g. Wika no. 4184 from the firm of Hans Wit Vogelsangstr. 15, 7000 Stuttgart 1.
Dial indicator (scale division 0.01 mm) with measuring-stem thread	1 687 233 012

C2

3. Exchange pump

The distributor-type fuel-injection pump 0 460 416 001 has been included in the exchange program with index no. 090.

4. Repair time

Work units for repair and testing of VE..F.. distributor-type fuel-injection pumps with LDA have not yet been published. The highest no. of units for complete dismantling is 45 AW.

Testing and adjusting with the elimination of a slight fault (e.g. leakage) should take 20 AW. These values are only provisional.

5. Timing the pump to the engine

The timing of this distributor-type fuel-injection pump is carried out by the pointer method.

Timing point:

Pump:
The pointer on the cam roller ring must line up exactly with the marking on the cam plate when viewed through the timing window. This corresponds to a plunger lift of 1 mm after BDC.

Engine:
3° after TDC, cyl. 1.

Please contact the Volvo representation in your district in order to find out the sales figures for these commercial vehicles. Please then see that the necessary tools and service parts are available at the right time and offer your assistance with after-sales service work.

VOLVO TRUCKS WITH ENGINE TD 60.. VDT-I-VOL 023 En

10.1980

Fuel-injection pump PES .. 6 MW .. with

Governor RQV .. MW

Manifold pressure compensator (LDA)
mounted on governor housing

The complaints listed below regarding the truck and/or its engine can occur due to the following reasons: "dry" friction at the LDA bolt, rust and wear as a result of friction at the closure cap and the sleeve for the full-load adjustment (or at the sleeve's contact surface).

1. The engine accelerates poorly, or not at all, in the lower engine-speed range.
2. Excessive smoke figures in the lower speed range.
3. Excessive smoke figures (excessive power) in the upper engine-speed range - danger of overheating
4. Maximum torque has shifted in the direction of lower engine speeds, this indicates higher smoke values at maximum torque.

Fault description:

1. The fault arises as a result of friction at the LDA bolt (O-ring).
2. Wear on the end of the sleeve and/or on the contact surface in the LDA.

In the case of such types of complaint, and when checking and readjusting pumps with the LDA (manifold pressure compensator) mounted on the governor, the ease of movement of the LDA bolt must be checked.

Before carrying out the full-load adjustment, the sleeve and the contact surface are to be checked for wear and replaced if necessary.

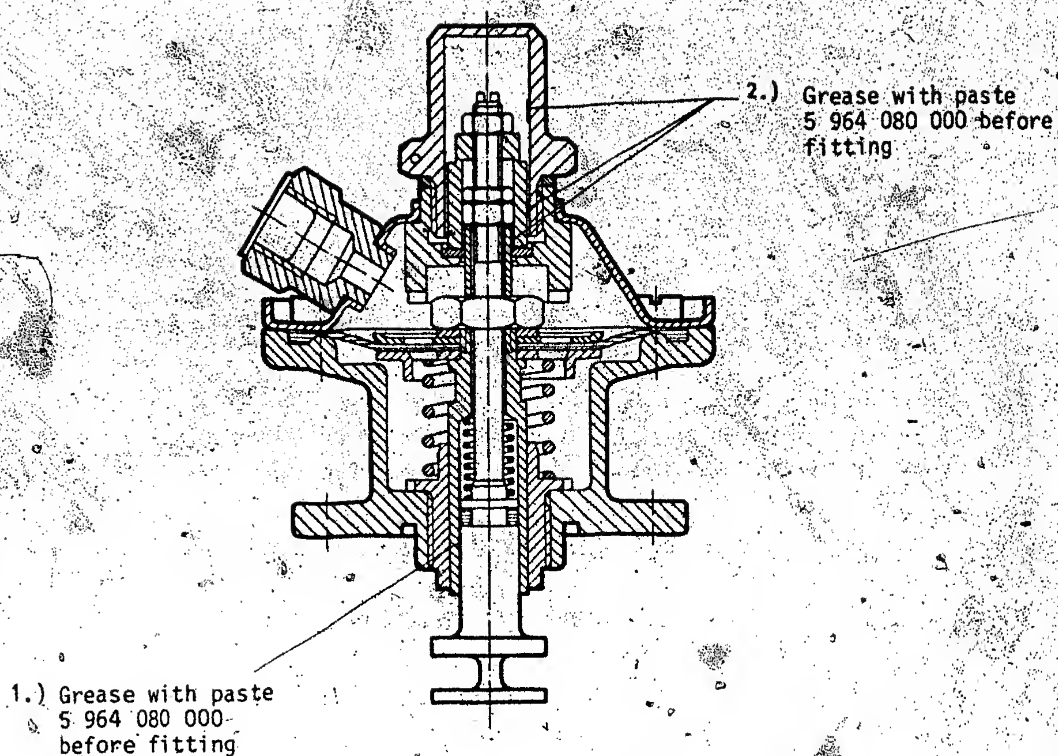
In order to remedy the complaints the following work is necessary:

Fault type 1	Disassemble the LDA and grease the O-ring and/or the bearing surface with paste 5 964 080 000.
Fault type 2	Disassemble the LDA and grease the O-ring and/or the bearing surface. Fit a new sleeve - grease the sleeve and the closure cap. Readjust the pump and the LDA.

Complaints which arise within the normal warranty period are to be accounted using the conventional warranty application.

RQV 300 ... 1400 MW 6 = 0 420 083 002

RQV 300 ... 1250 MW20 = 0 420 083 017



C5

Citroën Type CX 2200 Diesel

VDT-I-CIT 001 B

with VA distributor-type fuel-injection pump

May 1976

As from April 1976 Citroen will use the distributor-type fuel-injection pump 0 460 394 031 – EP/VA 4/90 H 2250 CL 186 in vehicle CX 2200 Diesel with engine GRD 90 L (4 Cylinder, 4-stroke Diesel, 66 HP – 49 kW – nominal speed 4,500 (rev/min), engine swept volume 2.175 l, firing order 1-3-4-2).

Nozzle-holder Assembly

The nozzle-and-holder assembly 0 432 287 048 is made up of the following parts:

Nozzle-holder assembly	0 431 202 154	KB 50 S 621/13
Nozzle	0 434 250 060	DN 0 SD 189

(Opening pressure 120 + 5 bar overpressure)

Fuel Filter

The Purflex-Filter CP 30 ADK is used: Bosch part number 9 459 990 558. The corresponding fuel-filter element has the part number 9 879 993 013.

After-sales Service Notes

After-sales service is provided in the normal way. The additional technical documents required have been distributed.

1. Technical Documentation

1.1
Repair Instructions for EP/VA .. C ..
VDT-WJP 161/4 B, Suppl. 1 ... 3

1.2
Test Instructions for EP/VA .. C ..
VDT-WPP 161/4 B, Suppl. 1, 2

1.3
For technical information see document list under "Distributor-type Pumps".
VDT-W-000/50

1.4
Service Parts List and Test Specification on microfiche.

1.5 Tools

1.5.1
For tools used on the test bench see WA-Catalog "Workshop Equipment Accessories" and "Special Accessories for Injection Pump Test Benches".
WA-VKF 053/1

1.5.2
Assembly Tools (After-sales Service Tools)
KD Tool Catalog
VDT AHA 060/1 of July 1973 including Catalog Sheet KD-EP 9 D of Nov. 1975.

2. Matching the Pump to the Engine

The matching of the distributor-type fuel-injection pump follows the dial indicator method

Setting Point
Pump at a plunger stroke of 0.45 mm after BDC
Engine 12 BTDC · plunger stroke 1.19 mm before TDC.

Please order the necessary service parts in good time so that efficient after-sales service can be provided.
Please get in touch with the Citroen representative in your area and offer him your servicing facilities.

BOSCH

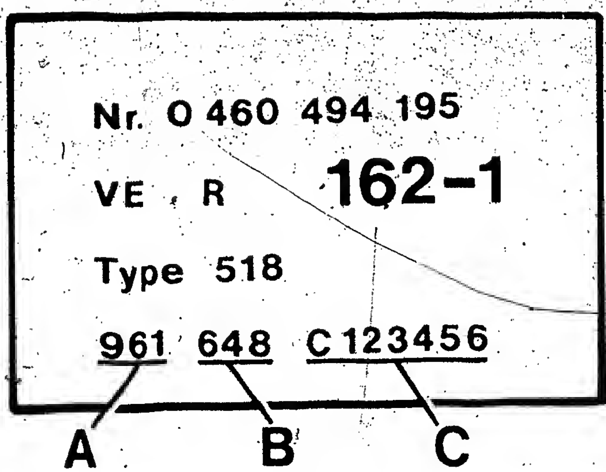
Geschäftsbereich KH Kundendienst Kfz-Ausrüstung
© by Robert Bosch GmbH, D-7 Stuttgart 1 Postfach 50. Printed in the Federal Republic of Germany
Imprimé en République Fédérale d'Allemagne par Robert Bosch GmbH

Register tab 2 vehicles
File
Identity VDT-I-CIT-005 En

CITROEN BX WITH XUD 9 ENGINE

Insufficient load pick-up 12.1986

at idle



A = Works code no.
B = Date of manufacture (FD)
C = Serial number

With this vehicle, it may come about in isolated cases that load pick-up is insufficient at idle. This expresses itself through an excessive drop in idle speed, e.g., when electrical consuming devices are switched on.
The engine "shakes" and the vibrations are clearly noticeable in the passenger compartment. The same effect can arise on sudden release of the accelerator.

| SERVICE INFORMATION | ===> |

The cause of this is a faulty idle spring in the distributor-type fuel-injection pump. However, this fault can arise only in fuel-injection pumps with the works code no. 961 and which are stamped with the dates of manufacture 647 (7.1986) up to 649 (9.1986) (see figure).

The complaint can be elminated by exchange of the idle spring in accordance with VDT-I-460/147.

Within the warranty period, this operation will be carried out for the customer free of charge.

Fuel-injection pumps which have the above-stated works code no. and dates of manufacture, but also have a white dot on the control lever have already been equipped at the works with the correct idle spring and do not need attention. The complaint has other causes which must be determined.

Published by:

ROBERT BOSCH GMBH
Division KH
Technical After-Sales Service (KH/VKD2)

Please direct questions and comments concerning the contents to our authorized representative in your country.

[redacted]

Fiat 131 and 132 Diesel
with VE..F..
distributor-type fuel-injection pump

VDT-I-FIA 014 En
12.1981
(Supersedes 5.81 Edition)

This publication has been redesigned with the forth-coming change-over to microfilm in mind.
When a publication has been transferred to microfilm, the screen will be filled completely by a quarter of a printed publication page. For this reason, it is unavoidable that illustrations are repeated in the case of longer texts in which reference is constantly being made to a particular illustration.
Until the change-over to microfilm, we have slightly reduced the size of the print and of the illustrations.

Contents:

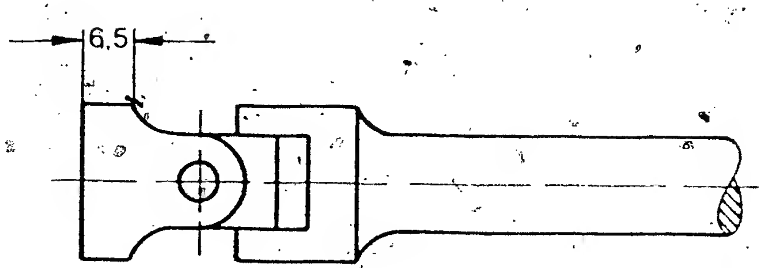
Automotive Equipment - After-Sales Service
Department for Technical Publications KH/VDT, Postfach 50, D-7000 Stuttgart 1
Published by: After-Sales Service Department for Training and Technology (KH/VSK). Press date: 3.81.

C10

1. Tools

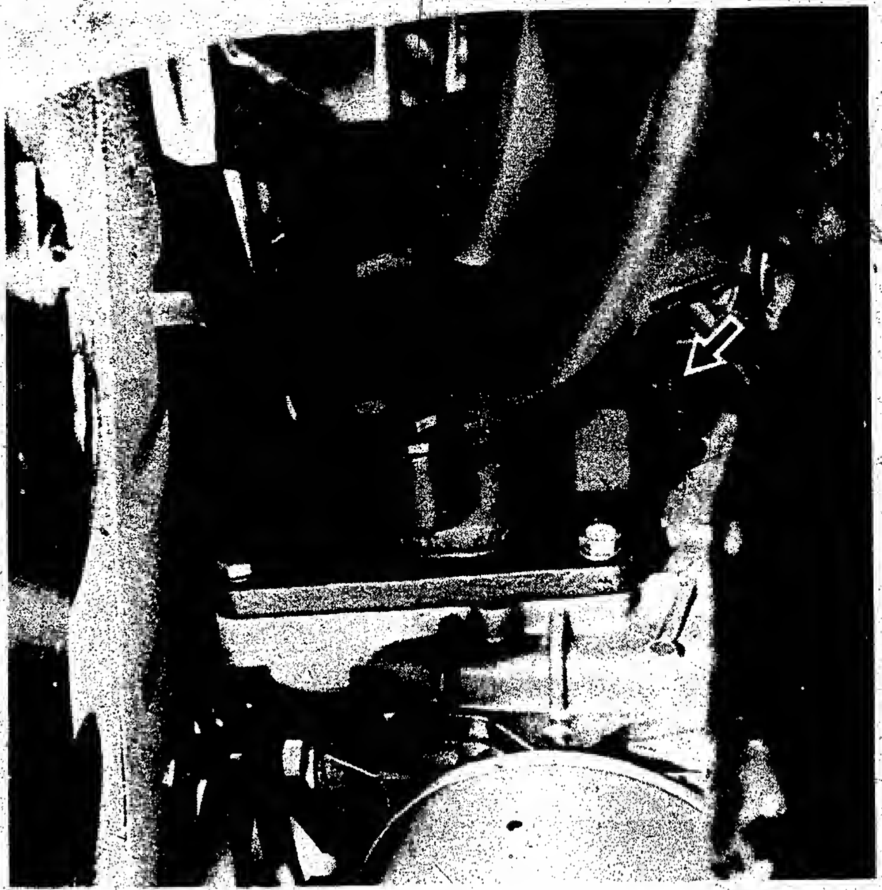
Setting mandrel	KDEP 1112	For checking the engine timing
*Short-arm swivel wrench	Hazet Co., Postfach 101067/68 5630 Remscheid 1 Part No. 2742	For fastening the fuel-injection pump with the vacuum pump installed
Measuring tool	KDEP 1085	Injection timing
Dial indicator commercially available 1/100 mm graduations		Injection timing

*The socket section of the short-arm swivel wrench must be turned to size according to the following sketch:



For machining, screw off the socket section and use a carbide cutting tool.

C11



1

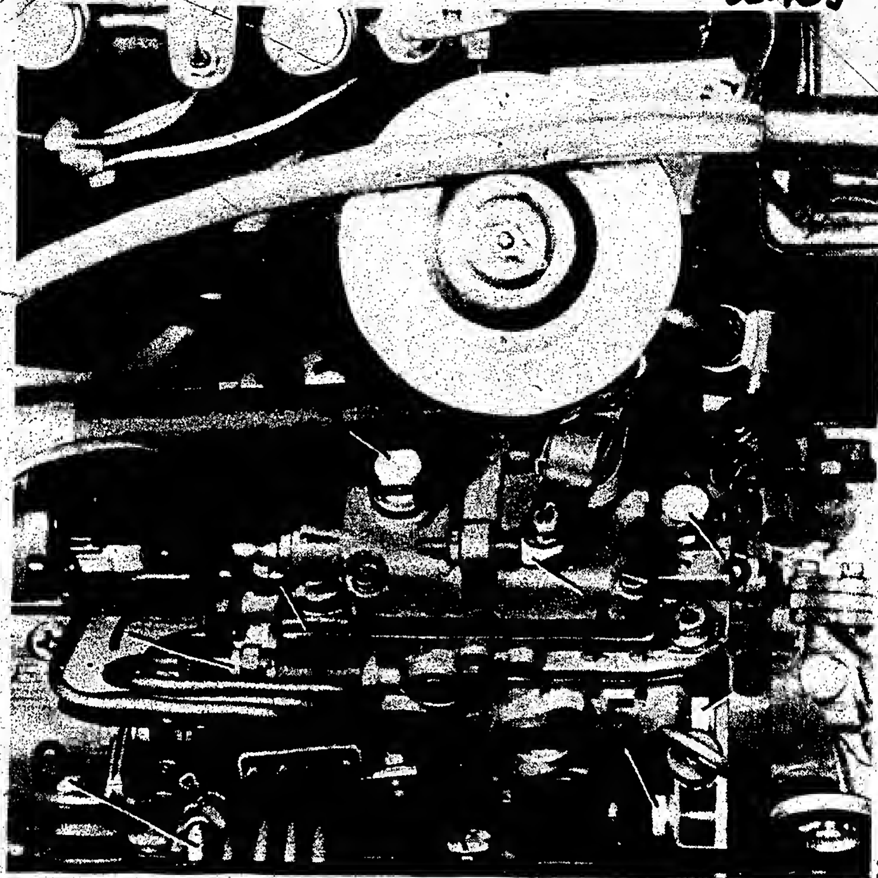
2. Removing the fuel-injection pump

Disconnect the negative cable (-) from the battery.

Loosen screw (5) (see Fig. 2) for oil dipstick holder and remove oil dipstick holder.

Raise the vehicle by means of a lifting platform and, from underneath the vehicle, loosen the lower fastening nut (Fig. 1) of the injection pump using the short-arm swivel wrench (see Section 1: Tools) and take off by hand.

Seite 3



2

Remove Bowden cable from control lever (1) of injection pump.

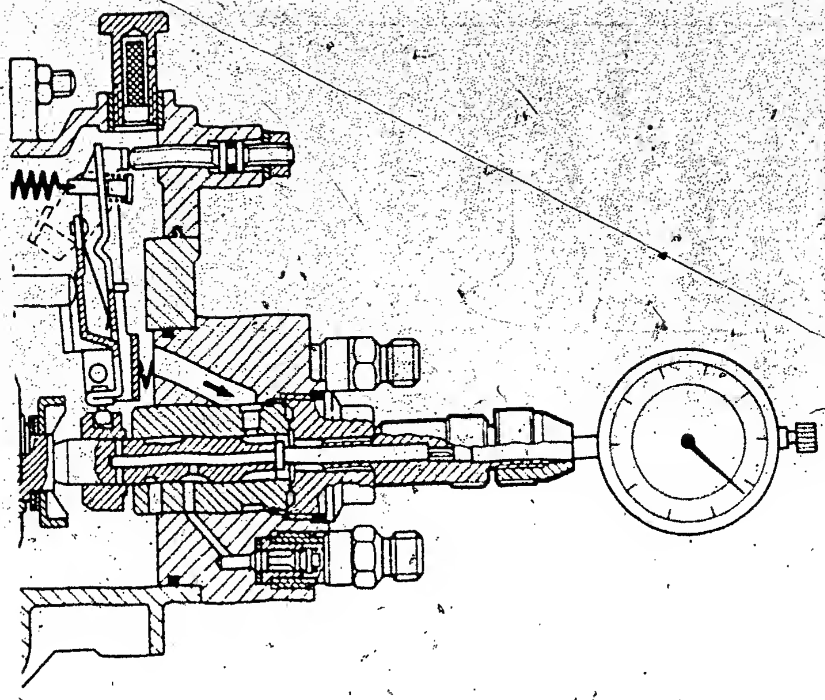
If fitted: Remove Bowden cable from KSB (cold-start accelerator).

Screw off fuel inlet and return lines (2) (3) on injection pump.

Remove electric lead from solenoid-operated valve (4).

Take off hood of injection nozzles: Remove leakage-fuel return line (6) from injection nozzles. Remove fuel-injection tubing (7). Remove fastening nuts (8) with plain washers.

Take off holder for "Accelerator-cable sleeve" from fuel-injection pump.



3. Installing the fuel-injection pump and injection timing

Fit the holding bracket for the accelerator-cable sleeve.

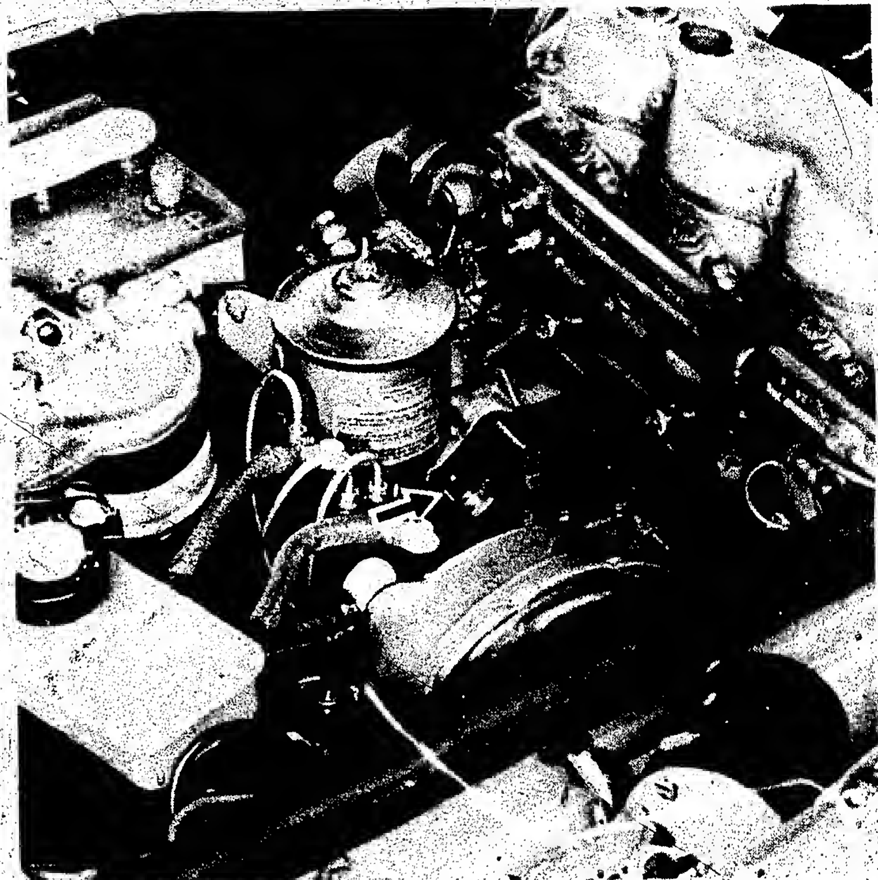
Remove the bleeder screw from the distributor-type fuel-injection pump.

Screw measuring tool KDEP 1085 into the central screw plug on the injection pump.

Fit dial indicator in measuring tool with measuring base and approx. 1 mm preload.

Fuel-injection pumps with KSB: KSB lever must be in "0-position".

Turn injection pump drive shaft so that the distributor-pump plunger is in BDC position (smallest reading on dial indicator).

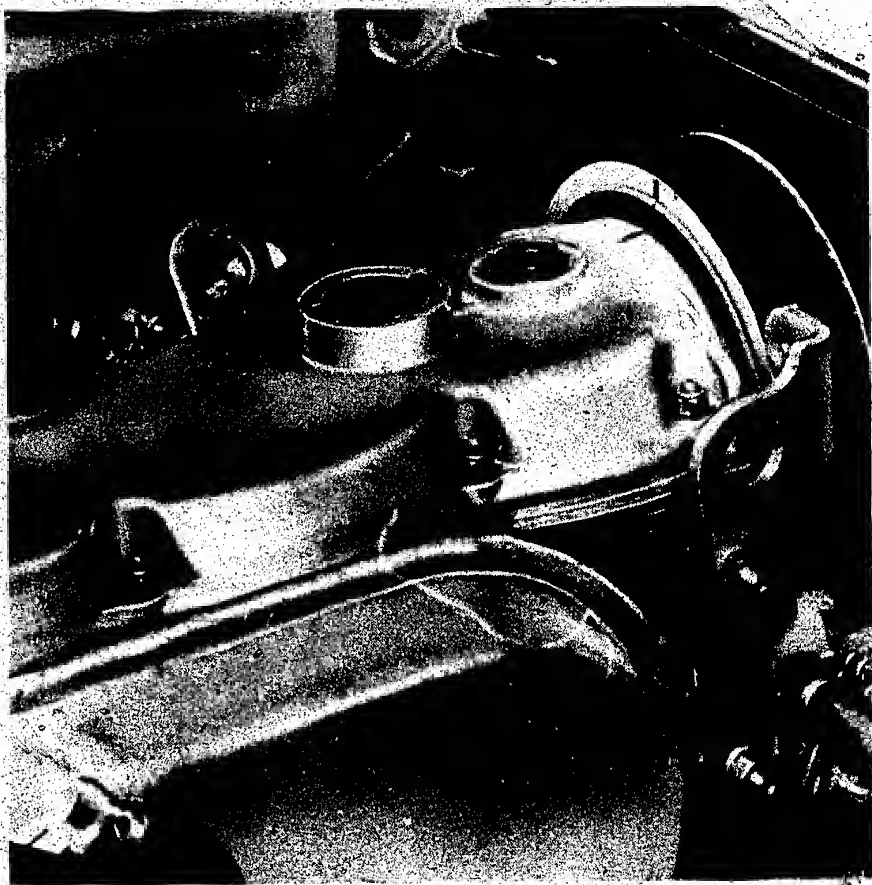


4

In this position, set the dial indicator with approx. 0.5 mm preload to "0".

Remove the cyclone separator (liquids/oil vapours).

Introduce the injection pump so that the markings on the pump pinion and pump drive gear ("Lost tooth") are in alignment.



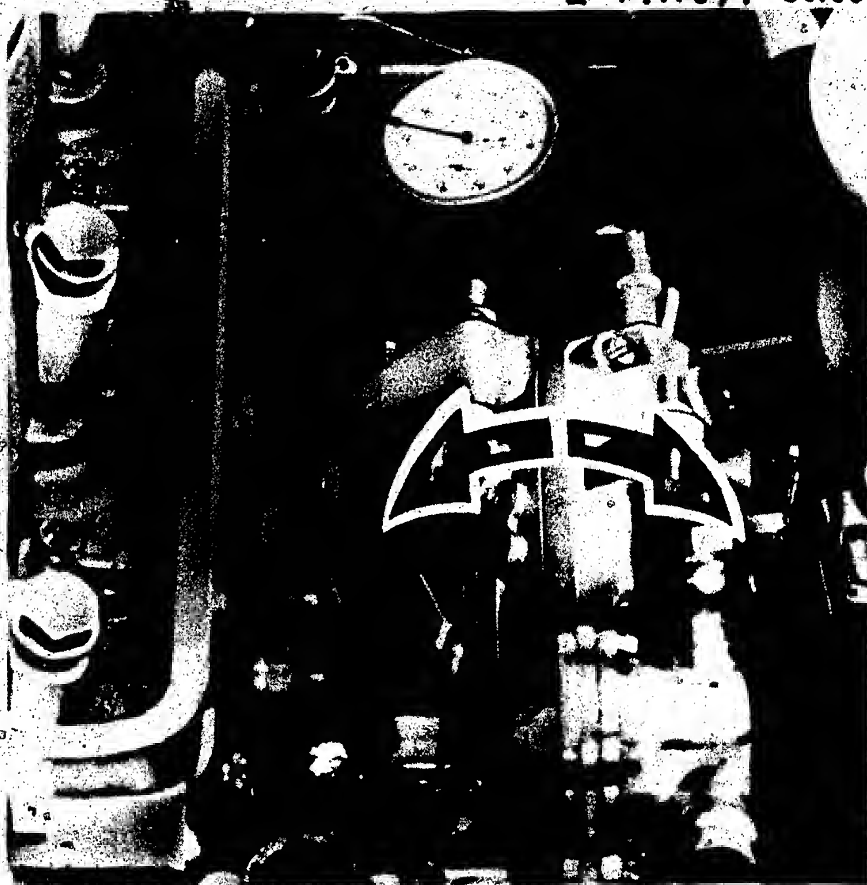
5

If necessary, turn the crankshaft against the direction of rotation of the engine so that the marking on the camshaft gear is approx. 10mm in front of the marking on the cylinder head cover (Fig. 5).

Screw on plain washers and hexagon nuts for fastening the pump (only upper fastening screws) but do not tighten.

Turn crankshaft in direction of rotation of engine until the markings on the camshaft gear and cylinder head cover are in alignment.

I-FIA014 Seite



6

3.1 Injection timing

Check the engine timing in accordance with Section 6.

Pivot the injection pump in a clockwise direction until the dial indicator indicates a distributor-pump plunger stroke of 1 mm from BDC.

Screw down the injection pump in this position by means of the upper fastening nuts.

Check the position of the injection pump by turning the camshaft.

Remove measuring tool KDEP 1085 with dial indicator from the injection pump.

Screw bleeder screw with new seal ring into central screw plug and tighten to 8 ... 10 Nm (0.8 ... 1.0 kgfm).

Raise vehicle by means of lifting platform.

Screw on lower fastening nut of injection pump by hand (from underneath vehicle) and tighten with short-arm swivel wrench (see Section 1: Tools).

7

3.2 Installing the individual parts

Screw the fuel-injection tubing (7) onto the injection pump and injection nozzles.

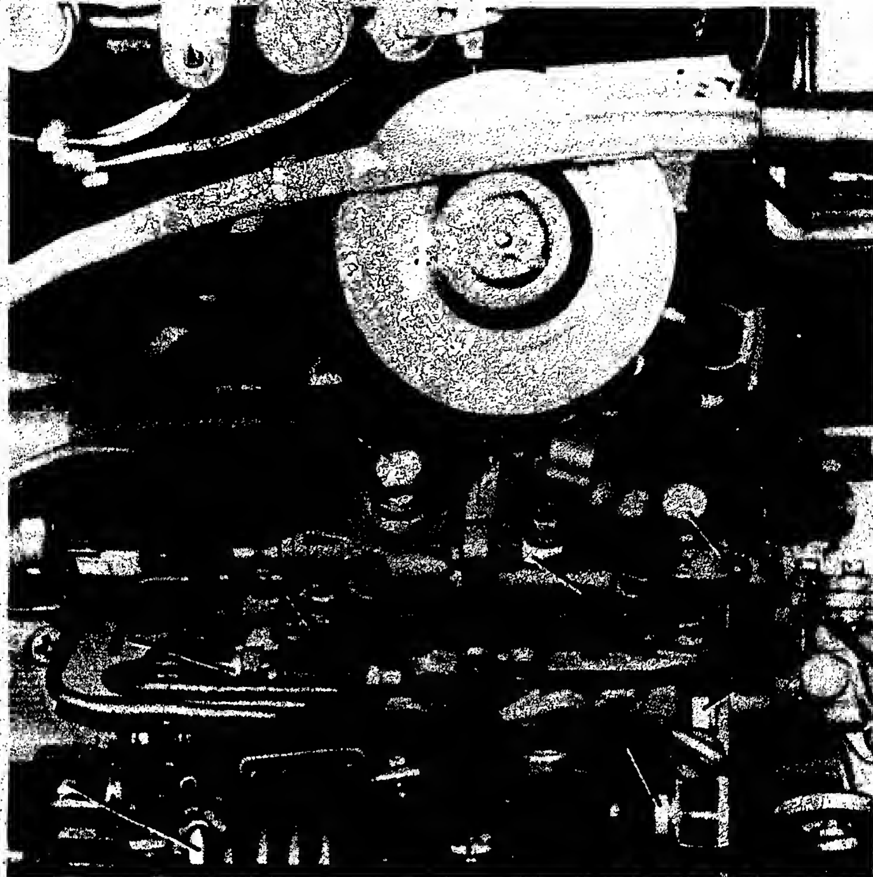
Tighten the union nuts to 25 Nm (2.5 kgfm).

Fit the leakage-fuel return line (6) on the injection nozzles.

Screw down the fastening screw (5) for the oil dipstick holder.

Connect the electric lead for the solenoid-operated valve (4).

During the following operation make sure that the inlet-union screws for the fuel inlet and return lines are not mixed up. Distinguishing feature: Inlet-union screw (throttle screw) for return has a small restriction bore on the circumference.



8

Connect the fuel inlet and return lines (2) and (3) to the injection pump.

Fit the Bowden cable from the accelerator to the control lever (1).

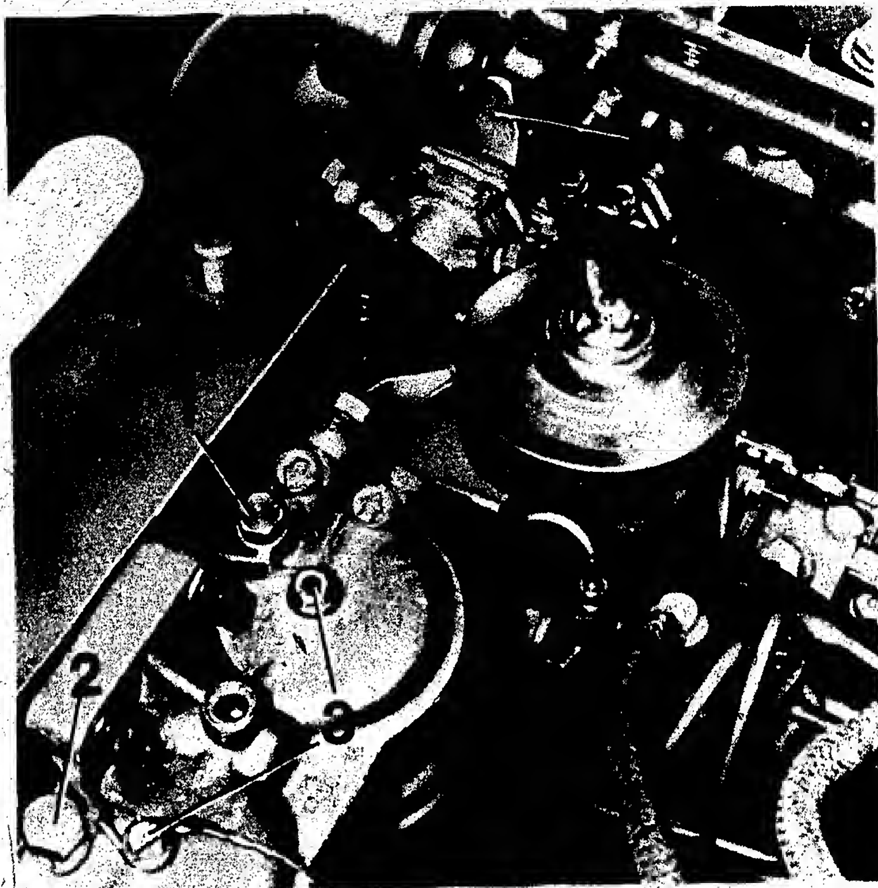
If fitted: Hook the Bowden cable of the KSB into the operating lever on the injection pump. Fit the hoses to the injection nozzles.

Connect the negative cable (-) to the battery.

Bleed the fuel-injection system in accordance with Section 4.

C20

Seite 5

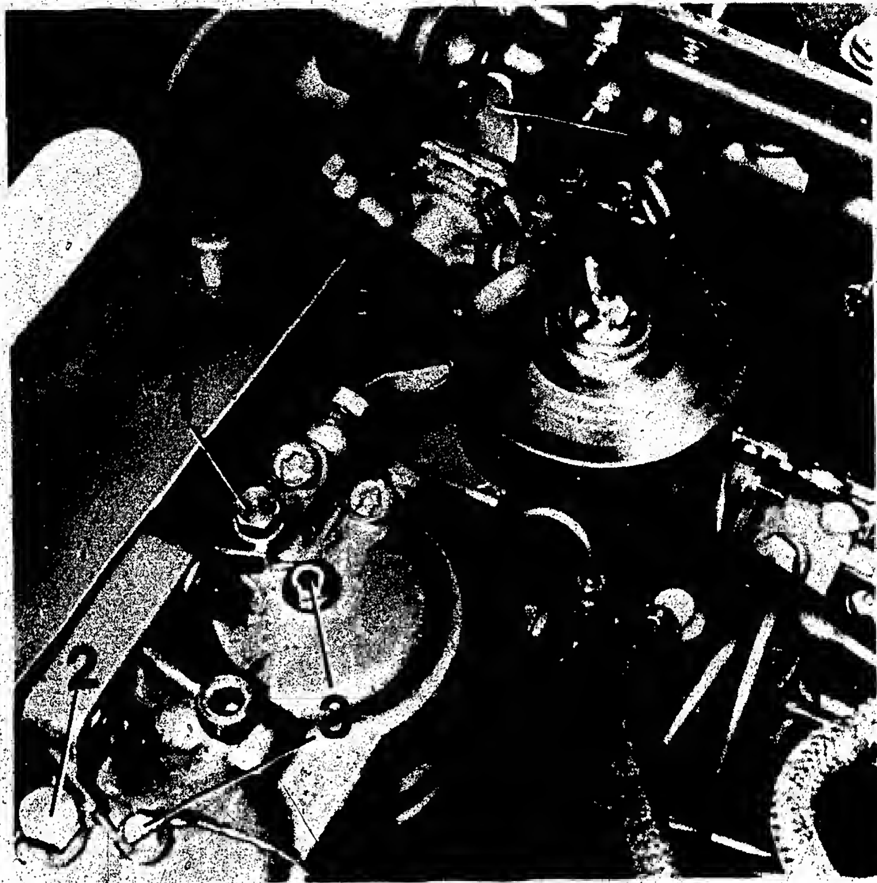


9

4. Bleeding the fuel-injection system

Loosen the bleeder screw (1).
Operate the hand primer (4) until the fuel escaping at the bleeder screw is free of bubbles. Re-tighten the bleeder screw (1).

Loosen the bleeder screw (2).
Operate the hand primer (4) until the fuel escaping at the bleeder screw is free of bubbles.
Re-tighten the bleeder screw (6).



10

4.1 Changing the filter elements

Loosen the hexagon screws (3).

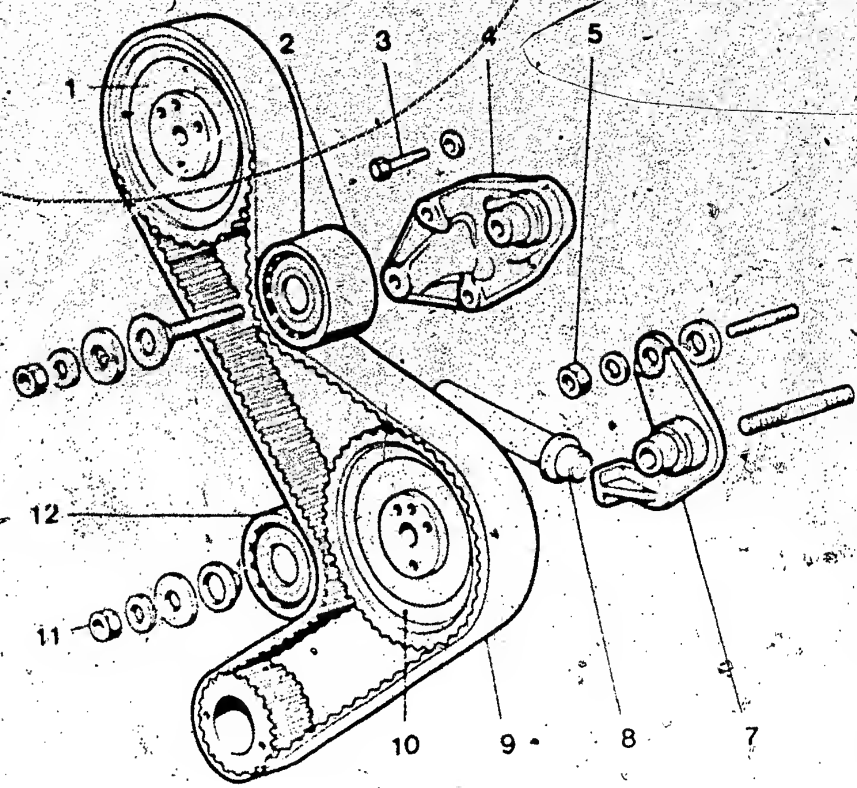
Remove filter elements together with tubular carrier.

Before fitting new filter elements, clean the tubular carrier with gasoline.

After fitting new filter elements, bleed the fuel-injection system. (See Section 4).

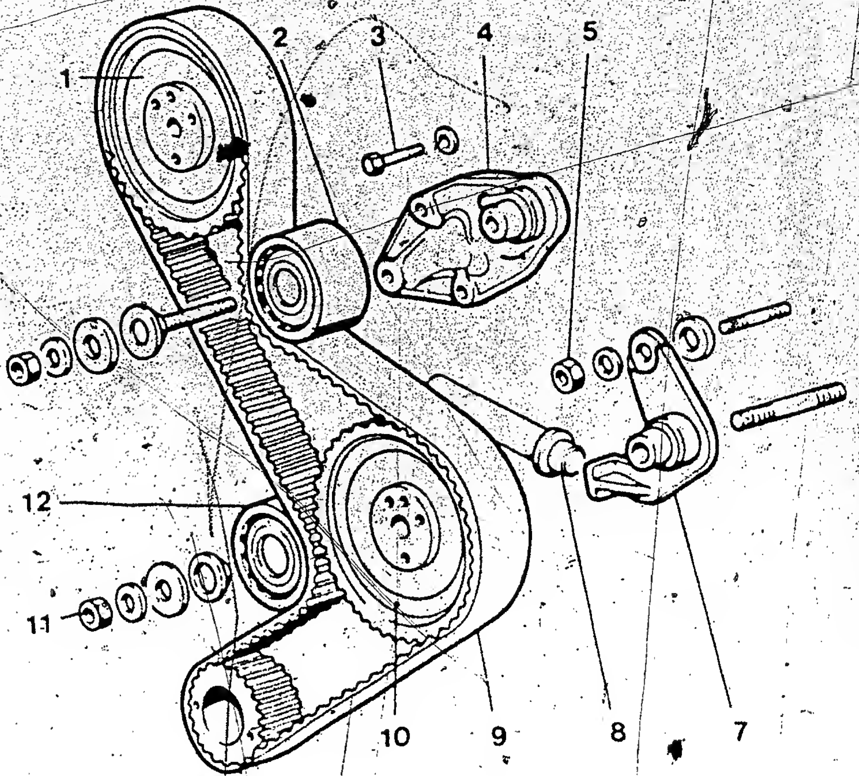
Draining the water separator:

After loosening the drain plug (on the base of the filter) the water separator can be drained.



5. Adjusting the tension of the toothed belt

1. Camshaft gear
2. Upper tensioning roller
3. Fastening screw for Item 4
4. Tensioner holder
5. Fastening nut for Item 6
6. Holder for Item 12
7. Spring tensioner
8. Toothed belt
9. Auxiliary-drive-shaft gear.
10. Drive gear on crankshaft
11. Fastening nut for Item 12
12. Lower tensioning roller - adjustable



Slacken the hexagon nut (11) for the lower tensioning roller.

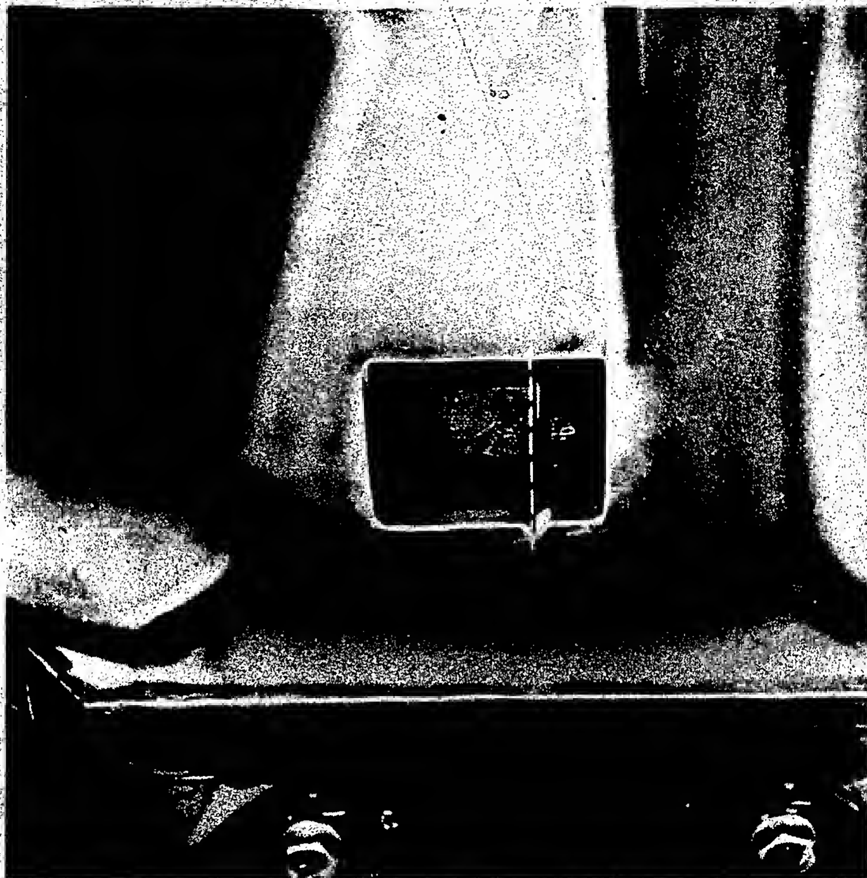
The spring-loaded tensioning roller can now act against the toothed belt.

Tighten the lock nut (11).

Turn over the crankshaft 1 - 2 revolutions in the direction of rotation of the engine.

Slacken the hexagon nut (11) and tighten again.

C24



13

6. Checking the engine timing

Take off the hood of the injection nozzles. Remove protective cover of toothed belt.

Bring piston of cyl. 1 (engine) into TDC position. Cylinder 4 is on overlap.

In this position, the markings on the flywheel and clutch housing must be in alignment.

Check the alignment of the markings on the camshaft drive gear and cylinder head cover.

Check the position of the auxiliary-drive-shaft gear (Item 9 Fig. 11) and of the crankshaft gear (Item 10, Fig. 11) using the setting mandrel KDEP 1112.

Remove the setting mandrel.

7. Tightening torques

Injection pump fastening nuts	25 Nm (2.5 kgfm)
Injection pump bleeder screw	9 Nm (0.9 kgfm)
Pump drive pinion fastening nut	65 Nm (6.5 kgfm)
Fuel-injection tubing	25 Nm (2.5 kgfm)
Fuel lines	25 Nm (2.5 kgfm)
Screw for injection nozzle bracket	49 Nm (4.9 kgfm)
Nut for belt tensioner M 10 x 1.25	45 Nm (4.5 kgfm)
Nut for belt tensioner holder M 8	25 Nm (2.5 kgfm)
Sheathed-element glow plugs	15 Nm (1.5 kgfm)

C26

FIAT RITMO DIESEL — VDT-I-FIA 022 En

with VE 4/9 F 2300 R 54 — 2.1983

0 460 494 044 — (Supersedes 6.1982 edition)

Optimization of warm-up phase

In order to improve the warm-up phase, FIAT has released a modified timing-device cover for vehicles with heavy blue smoke generation.

This timing-device cover KDEP 1129 can be ordered from KH/VKD4. Unit price DM 3.50. Minimum order 10 units.

Conversion is subject to payment in all cases.

In case of conversion, remove the distributor-type pump and proceed as follows:

1. Replace the pressure-side timing-device cover with a special cover KDEP 1129.
2. Set the injection timing.

   Injection pump: 1.25mm $\pm$ 0.05 mm after BDC

   Engine: TDC mark cyl. 1 on flywheel
3. Mark the pump with a "1" after the part number.
4. The testing and setting of the pump on the test bench do not change.

The modified timing-device cover KDEP 1129 can be obtained immediately within Germany from

Robert BOSCH GmbH
Abt. KH/VKD4
Auf der Breit 4
Postfach 41 09 60
7500 Karlsruhe 41 Telex 7 826 663

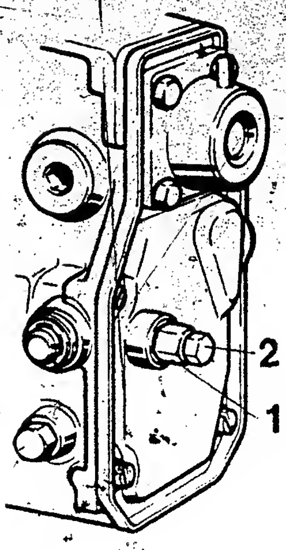
and outside Germany from RG/AV.

C27

BOSCH Geschäftsbereich KH Kundendienst, Kfz-Ausrüstung
© by Robert Bosch GmbH, D-7 Stuttgart 1, Postfach 50. Printed in the Federal Republic of Germany.
Imprimé en République Fédérale d'Allemagne par Robert Bosch GmbH

MERCEDES-BENZ
300 D - TURBO, 300 TD-TURBO
300 CD-TURBO, 300 SD-TURBO
Transverse shaking of engine
in lower idle-speed range

Fuel-injection equipment
VDT-I-MB 041 En
11.1984
supersedes edition 7.1984



1 = Locking nut 2 = Setting screw

On the above-mentioned vehicles with fuel-injection pumps 0 403 245 .. (PES 5 MW.. with RW governor) there may be complaints due to transverse shaking of the engine in the lower idle-speed range.

Corrective action:
The transverse shaking can be eliminated by engaging the damper (friction brake) in the RW governor.

	Motor Vehicle Service Information	→

BOSCH
Geschäftsbereich KH Kundendienst Kraftfahrzeug-Ausrüstung.
© by Robert Bosch GmbH, Postfach 50, D-7000 Stuttgart 1. Printed in the Federal Republic of Germany
Imprimé en République Fédérale d'Allemagne par Robert Bosch GmbH

D1

The damper is comprised of a setting screw and a locking nut and is located in the governor cover (see Fig.). By forcing the setting screw up against the driver (reverse-transfer lever of the sliding sleeve and the variable-fulcrum lever) the damper prevents engine shake in the lower idle-speed range.

Setting:

Bring the engine to operating temperature.
Loosen the locking nut (1).
At idle speed (750 ± 100 min^{-1}), screw the setting screw (2) in until the shaking stops. Do not screw in beyond this point. Finally, tighten the locking nut (1) with a torque of 20 - 25 Nm.

Note:

Only screw the damper in this far because otherwise the idling characteristic of the cold engine will be adversely affected.

Should the above-described action not eliminate the transverse shaking, it is possible to achieve a further improvement by reducing the dispersion of the fuel deliveries at idle.

To do this, remove the fuel-injection pump and have the equal delivery of the pump newly set on a pump test bench at a BD diesel workshop (see Technical Bulletin VDT-I-403/100).

Responsible:

Robert Bosch GmbH
Division KH
Technical After-Sales Service (KH/VKD 2)
Please direct questions and comments concerning the contents to our authorized representative in your country.

D2

G23

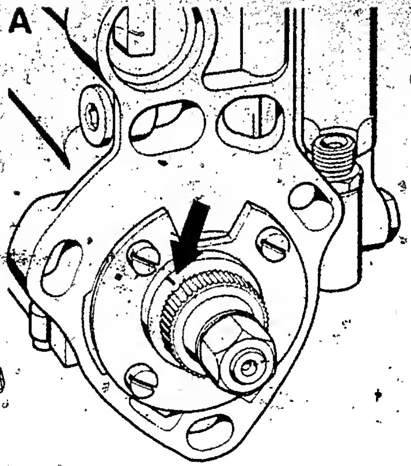
MERCEDES-BENZ 300 TD-TURBO
(Type 123 and 126 with engine OM 617)
Incorrect start-of-delivery marking on bearing end plate of fuel-injection pumps PES 5 MW ..
0 403 245 020 (USA)
0 403 245 022 (Europe)

VDT-I-MB 045 En
4.1983

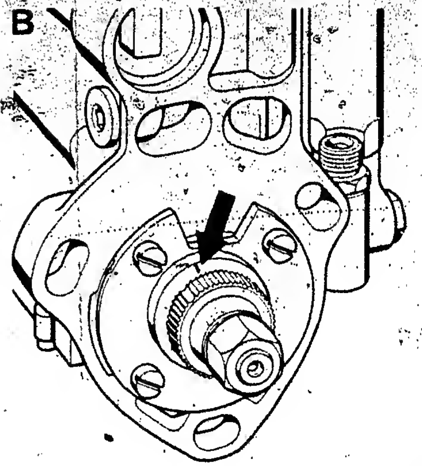
With some of the above mentioned fuel-injection pumps with FD 250 and FD 251 it is possible that the marking (arrow) for the start-of-delivery on the bearing end plate is not correctly positioned.

Fig. A shows the correct marking on the bearing end plate (marking approximately near the center of the bore for the upper-left fastening-screw of the bearing end plate).
Fig. B shows the incorrect marking on the bearing end plate (marking to the right of the bore for the upper-left fastening-screw of the bearing end plate).

A



B



Before the fuel-injection pump is fitted into the engine, it is important to see that with the incorrect marking on the bearing end plate (Fig. B) the marking on the driver of the cam shaft (missing tooth) must be turned three pinion teeth further to the left of the marking on the bearing end plate.
The position of the engine for fitting the injection pump (1st. cylinder 24° before TDC) as well as the testing or adjustment of the start-of-delivery remain the same.

BOSCH
Geschäftsbereich KH Kundendienst. Kfz-Ausrüstung.

D3

MERCEDES-BENZ 240 D, 300 D

VDT-I-MB 047 En

11.1984

supersedes Ed. 6.1984

Bucking in vehicles with fuel-injection pump PES..M with RSF governor

In the above-mentioned vehicles there may be the nuisance of bucking during vehicle operation.

The situation is improved by installing a thicker idle-speed auxiliary spring (2.0 mm instead of 1.5 mm).

Conversion:

- Remove tensioning lever 1 422 031 016 (service-parts list Item 16) with riveted-on idle-speed auxiliary spring as well as adjusting screw 1 423 412 017 (Item 52).
- Install new tensioning lever with thicker idle-speed auxiliary spring 1 422 031 026 and with likewise thicker adjusting screw 1 423 412 022.
- After converting, mark injection pump with red paint dot on governor housing (next to the pneumatic shutoff box).

Setting on pump test bench:

As a result of this modification the full-load setting point shifts from $n = 2200\ min^{-1}$
to $n = 2100\ min^{-1}$.

BOSCH Geschäftsbereich KH. Kundendienst Kraftfahrzeug-Ausrüstung.
© by Robert Bosch GmbH, Postfach 50, D-7000 Stuttgart 1. Printed in the Federal Republic of Germany.
Imprimé en République Fédérale d'Allemagne par Robert Bosch GmbH.

In addition, test point 5 in the test-specification sheet under Section B in columns 1 - 3 is also deleted.

In the text part of the test-specification sheet under point 2 "Setting the idle control-lever position", the test speed changes

from $n = 1000\ \text{min}^{-1}$

to $n = 1100\ \text{min}^{-1}$.

This conversion is subject to payment.

Responsible:

Robert Bosch GmbH
Division KH
Technical After-Sales Service (KH/VKD 2)

Please direct questions and comments concerning the contents to our authorized representative in your country.

Fuel-injection equipment

MERCEDES-BENZ 200 D, 240 D, 300 D — VDT-I-MB 048 En

Sticking of shutoff boxes on fuel-injection pumps PES..M.. with RSF governor and PES..MW.. with RW governor — 5.1984

In some of the above-mentioned vehicles it is possible for the control rod to stick.

The cause may be a defective shutoff box with unequally bent guide rails or a rivet head which is too large.

In case of complaint:
"Control rod sticking", before removing the injection pump first of all check the shutoff box for the above-described faults and renew if necessary.

The fault on the shutoff box may possibly only be detectable if a lateral force is exerted on the drive hub.

Due to appropriate measures in series production the above-mentioned faults no longer occur on assemblies as of FD 350 (Oct. 1983).

Please direct questions and comments concerning the contents to our authorized representative in your country.

Motor Vehicle Service Information

BOSCH

Geschäftsbereich KH Kundendienst Kraftfahrzeug-Ausrüstung
© by Robert Bosch GmbH, Postfach 50, D-7000 Stuttgart 1. Printed in the Federal Republic of Germany
Imprimé en République Fédérale d'Allemagne par Robert Bosch GmbH.

D6

This information is available only in German. If necessary, please contact your regional representative.

Cette information n'est disponible qu'en allemand. Le cas échéant, veuillez vous adresser à votre représentation régionale.

Esta información está disponible únicamente en alemán. En caso necesario, sírvase dirigirse a su Representación Regional.

Questa informazione è disponibile solo in lingua tedesca. Se necessario, rivolgersi al proprio rappresentante di zona.

D7

This information is available only in German. If necessary, please contact your regional representative.

Cette information n'est disponible qu'en allemand. Le cas échéant, veuillez vous adresser à votre représentation régionale.

Esta información está disponible únicamente en alemán. En caso necesario, sírvase dirigirse a su Representación Regional.

Questa informazione è disponibile solo in lingua tedesca. Se necessario, rivolgersi al proprio rappresentante di zona.

This information is available only in German. If necessary, please contact your regional representative.

Cette information n'est disponible qu'en allemand. Le cas échéant, veuillez vous adresser à votre représentation régionale.

Esta información está disponible únicamente en alemán. En caso necesario, sírvase dirigirse a su Representación Regional.

Questa informazione è disponibile solo in lingua tedesca. Se necessario, rivolgersi al proprio rappresentante di zona.

D9

OPEL REKORD DIESEL 2.0 and 2.3 D
with VE..F.. distributor-type fuel-injection
pumps L 28 and L 37

VDT-I-OPE 021 En

3.1983
(Replaces Ed. 1.1982)

Cold start difficulties

Cold start difficulties occasionally occur in the above-mentioned vehicles.

Remedy

Correct the start of injection (advanced adjustment) in the starting range by fitting a modified timing-device cover with a 2 mm collar. Conversion can be carried out without removing the fuel-injection pump.

Procedure

1. Remove the vacuum pump.

2. Check the start of delivery and correct, if necessary:

   2.0 l : start of delivery = 1.04 mm after BDC, engine TDC

   2.3 l : start of delivery = 0.93 mm after BDC, engine TDC

3. Exchange the original timing-device cover 1 461 074 302 (pressure side) for the modified timing-device cover KDEP 1129 (see drawing 1). Before fitting, this modified cover must be marked with your workshop designation.

   If the conversion is made with the pump removed, then the pump must be timed to the engine as follows:

   2.0 l : start of delivery = 1.30 mm after BDC, engine TDC

   2.3 l : start of delivery = 1.24 mm after BDC, engine TDC

   The start of delivery given above (1.30 mm and 1.24 mm) is therefore the start of delivery of the distributor-type fuel-injection pump with new timing-device cover.

   The modified timing-device cover KDEP 1129 can be ordered outside of Germany from your RG/AV.

   DM 3,50 per item - minimum purchase 10 items

The cover (see drawing 2) can be user-fabricated as follows:

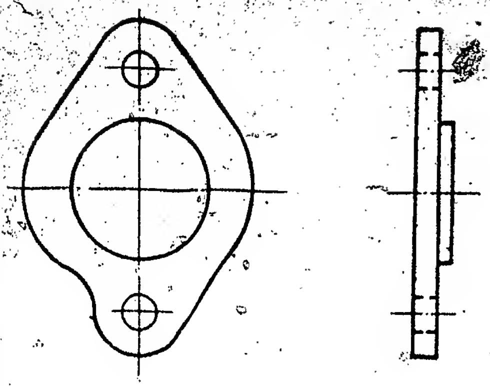
1. Drill out the center of a steel disk (dia. 22 mm x 2 mm thick) to a diameter of 6mm. Drill and countersink holes for M6 countersunk-head screws on one side.

2. Drill out the center of the original cover 1461 074 302 to a diameter of 6 mm.

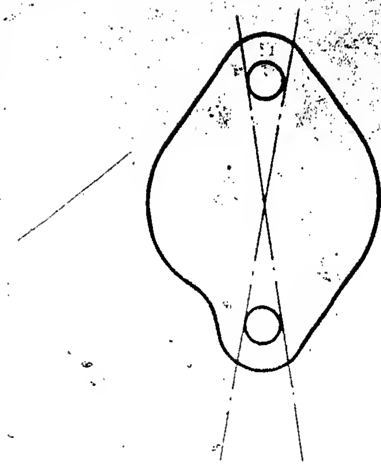
3. Attach the steel disk to the inside of the timing-device cover using suitable countersunk-head screws (M6 x 10), snap rings and nuts sealed with Loctite.

Costs

This modification is to be charged to the customer.



Drawing 1



Drawing 2

OPEL KADETT DIESEL, ASCONA DIESEL
Distributor-type fuel-injection pump
with special overflow throttle

Distributor-type fuel-injection pumps (VE) for Opel Kadett and Ascona Diesel are not fitted with overflow throttles (Fig. 1), but with overflow throttle fittings (Fig. 2 - Opel part).

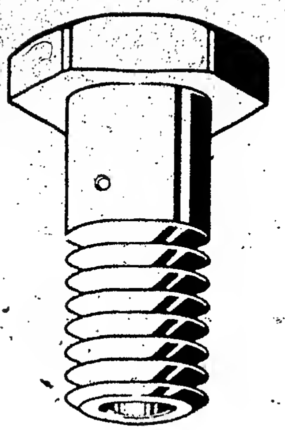


Fig. 1

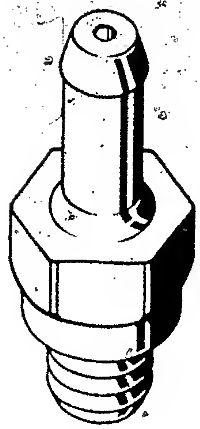


Fig. 2

Before testing and setting VE pumps, the overflow throttle fitting (Opel part) must be removed. To do this screw in the overflow throttle according to the service-parts microfiche (marked with "out") and test or set the pump with this.
Finally exchange the Bosch overflow throttle again for the overflow throttle fitting (Opel part).

D12

PEUGEOT TYPE 305 D
with VE..F.. -distributor-type fuel-injection pump

VDT-I-PEU 010 En
7.1980
Replaces Ed. 10.1978

Since June 1980 the Peugeot 305 D has been fitted with a VE..F..-distributor-type fuel-injection pump with part-load governor, mechanical and electrical shutoff-device and a stop for increased idle speed.

<u>Engine data:</u>

Engine	XID 4
Engine swept volume	1548 cm³
Output	37 kW (50 HP)
Rated speed	5000 min
Ignition sequence	1-3-4-2

Fuel-injection equipment:	10/78 - 6.80	from 6.80
Distributor-type fuel-injection pump	VE 4/8 F 25== L 29 0 460 484 003	VE 4/8 F 2500 L 60 0 460 484 005
Single-stage box-type filter	9 459 990 558	9 459 990 558
Fuel-filter box	1 457 431 028	1 457 431 028
Nozzle-and-holder assembly	0 432 217 060	0 432 217 069
Nozzle-holder assembly	KCA 17 S 33/4 0 430 211 046	KCA 17 S 38/4 0 430 211 049
Nozzle	DN 0 SD 1510 0 434 250 011	DN 0 SD 1510 0 434 250 011
Opening pressure	130 + 5 bar	130 + 5 bar

For complete Bosch equipment see microfiche.

<u>Timing the pump to the engine</u>

The pump is timed according to the dial indicator method.

Timing point:

pump: at a plunger lift of 0.5 mm after BDC
Engine: 8° before TDC

<u>Work units:</u>

Work units for repairing and testing have not yet been issued.

Provisional work units:

Complete dismantling and testing max. 35 AW
Testing, adjusting and eliminating a minor fault max. 16 AW

<u>After-sales service instructions:</u>

Please see that speedy after sales-service work is carried out on this vehicle in your workshop.

BOSCH
Geschäftsbereich KH Kundendienst Kfz-Ausrüstung
© by Robert Bosch GmbH, D-7 Stuttgart 1, Postfach 50. Printed in the Federal Republic of Germany
Imprimé en République Fédérale d'Allemagne par Robert Bosch GmbH

This information is available only in German. If necessary, please contact your regional representative.

Cette information n'est disponible qu'en allemand. Le cas échéant, veuillez vous adresser à votre représentation régionale.

Esta información está disponible únicamente en alemán. En caso necesario, sírvase dirigirse a su Representación Regional.

Questa informazione è disponibile solo in lingua tedesca. Se necessario, rivolgersi al proprio rappresentante di zona.

D14

PEUGEOT 604 D TURBO

with VE .. F ..
distributor-type fuel-injection pump

VDT-I-PEU 014 En
10.1980
Supersedes Ed. 6.1979

The VE..F.. distributor-type fuel-injection pump in the Peugeot 604 D with the XD 2 S engine is fitted with the following equipment: solenoid-operated shutoff device together with an additional mechanical shutoff device, manifold-pressure compensator (LDA), quiet-idle device (in the hydraulic head), load-dependent start of pump delivery (LAFB) and delivery-valve holder with integrated reverse-flow throttle.

Engine data

Water-cooled, 4-cylinder, 4-stroke diesel engine with whirl chamber (Ricardo Comet 5). Power output 59 kW (80 DIN HP) at a rated engine speed of 4150 min^{-1}. Engine swept volume 2.3 l, firing sequence 1-3-4-2, compression 21:1.

Fuel-injection equipment

Distributor pump (for vehicles with manual-shift transmission)	0 460 404 003 - VE 4/10 F 2075 R 40 (approx. qty. 6,000 delivered)
As from September 1979	0 460 404 008 - VE 4/10 F 2075 R 40 - 2
As from June 1980	0 460 404 011 - VE 4/10 F 2075 R 62
Distributor pump (for vehicles with automatic transmission)	0 460 404 004 - VE 4/10 F 2075 R 40 - 1 (approx. qty. 2,000 delivered)
As from September 1979	0 460 404 009 - VE 4/10 F 2075 R 40 - 3
As from September 1980	0 460 404 018 - VE 4/10 F 2125 R 62/2

The modification refers to the functioning of the governor. Pumps .. 003 and .. 004 have idle-speed spring combinations. Pumps .. 008 and .. 009 have idle intermediate-spring combinations with which a strong puff of exhaust smoke is prevented when the engine is suddenly accelerated from idle when the vehicle is standing still. This is in compliance with French Technical Control Board Regulations.

Pumps .. 003 and .. 008 are fully interchangeable with one another, as are pumps .. 004 and .. 009.
Pump .. 011 and pump .. 018 are not interchangeable with their predecessor models.

BOSCH
Geschäftsbereich KH Kundendienst Kfz-Ausrüstung
© by Robert Bosch GmbH, D-7 Stuttgart 1, Postfach 50. Printed in the Federal Republic of Germany.
Imprimé en République Fédérale d'Allemagne par Robert Bosch GmbH.

Fuel filter

The Purflux-Filter CP 30 ADK is fitted.
The appropriate filter element has the Bosch Part Number 1 457 431 028.

Nozzle-holder assembly	old (as from 5/80)	new (as from 6/80)
Nozzle-and-holder assembly comprising:	0 432 217 060	0 432 217 069
Nozzle-holder assembly	0 430 211 046-KCA17S33/4	0 430 211 049-KCA17S38/4
Nozzle	0 434 250 011-DN0SD1510	0 434 250 011-DN0SD1510

Opening pressure 130+5 bar overpressure

See the Microfiche for the complete Bosch equipment.

Notes for after-sales service

The normal after-sales service is to be carried out for this VE..F.. distributor pump. The appropriate technical documentation has already been published.

A supplement is to follow for the Repair Instructions due to the quiet-idle device incorporated in the hydraulic head.

Test specifications can be obtained from KH/VSK 1, if required, until they are issued on microfiche.

Tools for repair and testing

The conventional tools listed in the catalog sheets KD-EP 11 are required for the repair of this VE..F.. distributor pump.

Tools and equipment required for testing

Timing-device-travel measuring device	1 688 130 139
Setting throttle	1 688 130 132
For checking the charge-air pressure:	
Pressure-reducing valve for compressed air, with pressure gauge 0...4 bar	Commercially available
Pressure gauge 0...1.6 bar (Quality grade 1.0)	Commercially available
Dial indicator (scale division 0.01 mm) Measuring-stem thread M 3	1 687 233 012

Exchange pump

The distributor pumps 0 460 404 008, ... 009, ... 011 and ... 013 have been included in the Exchange Program with the Index No. 090.

Repair times

The work-unit figures for repairing and testing the VE..F.. distributor pump fitted with the LDA have not yet been issued. Maximum values when the pump is dismantled completely: 45 AW.

Checking and adjusting together with the repqir of a minor fault (for instance, a leak): 20 AW.
These AW are only provisional.

Timing the pump to the engine

The distributor pump is timed according to the dial-indicator method.

Setting points

Pump: At a plunger stroke of 0.30 mm after TDC.

Engine: 10^{0} BTDC = 0.80 mm BTDC.

Please get into touch with the Peugeot representative in your area and ascertain the sales figures for these vehicles. Please make every effort to ensure that your workshop carries out impeccable and speed repair work on the fuel-injection system of these vehicles.

PEUGEOT 604 D VDT-I-PEU 021 En

with VE..F.. Distributor-type fuel-injection pump 5.1981

With increasing mileage, it can happen with these vehicles that complaints are received that the "Engine is putting out black smoke".
The reason for this complaint is that the delivery quantity has increased by 2-3 cm³
It is not necessary to remove the pump in order to alleviate this fault. It suffices to unscrew the full-load delivery screw by 0.2 mm. The screw is then to be locked again using locking paint.

Within the warranty period, this work is to be carried out for the customer free of charge and a warranty claim submitted to KH/VKD 3.
Time for repair is max. 1 AW.

BOSCH Geschäftsbereich KH Kundendienst Kfz-Ausrüstung
c. by Robert Bosch GmbH, D-7 Stuttgart 1, Postfach 50. Printed in the Federal Republic of Germany
Imprimé en République Fédérale d'Allemagne par Robert Bosch GmbH

D18

847

32C

We have received some complaints about blue smoke in connection with the above-mentioned vehicles.
The cause of this complaint can be:

1. incorrect setting of the load-dependent start of pump delivery (LFB).
2. coking of the injection nozzles

Remedy:

for point 1 : Set the start of pump delivery (LFB) at 1400 min^{-1} as in test sheet.

for point 2 : Exchange the fuel-injection nozzles. Instead of nozzles 0 434 250 011, nozzles 0 434 250 109 should be used.

During the guarantee period the setting of the load-dependent start of pump delivery (Lfb) will be carried out without any charge for the customer. The pump should be forwarded to KH/VKD 3 with a warranty claim form.
The customer will be charged for exchanging the nozzles.

BOSCH Geschäftsbereich KH Kundendienst Kfz-Ausrüstung
© by Robert Bosch GmbH, D-7 Stuttgart 1, Postfach 50. Printed in the Federal Republic of Germany
Imprimé en République Fédérale d'Allemagne par Robert Bosch GmbH

PEUGEOT 505 D TURBO, 604 D TURBO

VDT-I-PEU 024 En

9.1983

with VE distributor fuel-injection pump

VE 4/10 F 2075 R 62

With the above-named vehicles, it is possible for heavy smoke to be developed when the engine is running at idle. This is due to sooted nozzles resulting from unfavorable operating conditions.

In most cases, the fault can be remedied by taking the following measures:

Fit nozzles 0 434 250 109 (DNOSD 252) instead of nozzles 0 434 250 011 (DNOSD 1510), and set them to 150 bar. When installing, it is imperative that the heat-conducting washers PR 1981.02 and the copper seals PR 1981.05 are renewed.

New delivery-valve holders 1 463 370 342 (refer to Service-Parts Microfiche, Pos'n 58) with throttle bore dia. 0.6 mm must be fitted to the distributor pump. The delivery-valve holders can be exchanged without it being necessary to remove the pump. The pressure spring (Pos'n 56) and the spacer ring (Pos'n 57) do not have to be replaced by new ones. The tightening torque for the delivery-valve holders is 45-55 Nm.

The delivery-valve holders will be fitted as standard as from FD 347.

The replacement of the nozzles and the installation of new delivery-valve holders must be charged to the customer. This also applies during the warranty period.

BOSCH

Geschäftsbereich KH, Kundendienst, Kfz-Ausrüstung

© by Robert Bosch GmbH, D-7 Stuttgart 1, Postfach 50. Printed in the Federal Republic of Germany
Imprimé en République Fédérale d'Allemagne par Robert Bosch GmbH.

D20

VOLVO-Penta

VDT-I-VOL 012 B

10.1977

Marine engine TMD 40 A with VE distributor-type fuel-injection pump

The new distributor-type fuel-injection pump with electromagnetic shutoff device has been used by VOLVO-Penta on the marine engine TMD since March 1977.

Engine data

6 cyl. 4-stroke diesel, whirl chamber, 96 kW (130 HP) at a rated speed of 3,600 rev/min, engine swept volume 3.59 l, firing sequence 1-5-3-6-2-4, compression ratio 20.5:1.

Fuel-injection equipment

Distributor-type fuel-injection pump
0 460 416 002 - VE 6/11 F 1800 L 19

Fuel filter

Single-stage box-type filter 0 450 133 007 - FJ/DBR 1 W 6/225 with water reservoir and drain plug. Fuel-filter box 1 457 434 061.

Nozzle-holder assembly

Nozzle-and-holder assembly consisting of:		0 432 297 032
nozzle-holder assembly	KBE 36 SD 2/13	0 431 211 999
nozzle	DNOSD 193	0 434 250 063
opening pressure		175 bar gauge pressure

Service hints

Service is provided for the VE distributor-type fuel-injection pump in the normal way. The necessary technical documents have been issued.

Caution:
This distributor-type fuel-injection pump is fitted with a solenoid-operated valve. No voltage may be applied to the solenoid-operated valve while the pump is being tested on the pump test bench. Apply voltage to the solenoid-operated valve only when testing the shutoff function.

1. Technical documents

"New product" bulletin:
VDT-460/1 B

Repair instructions:
VDT-W-460/100 B

Test instructions:
VDT-W-460/300 B and 1st Supplement

Service-parts list:
Microfiche EP-142, column E3, edition 77/1

Test specifications:
on microfiche from September 77.

Bosch equipment:
Microfiche

Service tools:
Catalog sheet KD-EP 9 B (9.76)

2. Repair and test tools

For the repair of this VE distributor-type fuel-injection pump only the tools listed in catalog sheet KD-EP 9 B (9.76) are required provided that tools for EP/VA distributor-type fuel-injection pumps are already available.
These service tools should be ordered from your authorized representative.

The following additional items are required for testing:

Timing-device-travel measuring device	1 688 130 139
Intermediate piece M 8 x 1 (for adjusting the plunger lift to port closing in conjunction with the prestroke measuring device 1 688 130 045)	1 683 458 019

These items of test equipment should be ordered from your authorized representative.

3. Exchange pump

The distributor-type fuel-injection pump 0 460 416 002 has been taken into the exchange program under Index 090.

BOSCH

Geschäftsbereich KH, Kundendienst Kfz-Ausrüstung
© by Robert Bosch GmbH, D-7 Stuttgart 1, Postfach 50. Printed in the Federal Republic of Germany
Imprimé en République Fédérale d'Allemagne par Robert Bosch GmbH

D21

4. Repair time

Work unit figures for the repair and testing of the VE distributor-type fuel-injection pump have not yet been issued. Maximum figure for complete dismantling 35 work units (AW).

Checking and setting with elimination of a minor fault (e.g. a leak) 16 AW. These figures are provisional.

5. Matching the injection pump to the engine

Adjustment of this distributor-type fuel-injection pump is carried out by the pointer method.

Adjustment point

Pump:
The pointer on the roller ring must align with the mark on the camplate in the timing window. This corresponds to a plunger lift of 1 mm after BDC.

Engine:
5° after TDC 1st cyl.

Please contact the VOLVO-Penta dealer in your area to ascertain the sales figures for these engines. Ensure that the necessary tools and service parts are available in good time and make it known that you are ready and willing to offer service facilities.

Fuel Injection Equipment

VOLVO PASSENGER CARS — VDT-I-VOL 024 En
MODEL 240 Series D6 and MODEL 760 — 6.1985
VE... L32 and VE... L116
Complaints about black smoke — supersedes 2.1984

An increase in the fuel delivery by approx. 2 ... 3 cm^3/1000 strokes may lead in the above-mentioned VOLVO vehicles with these pumps to complaints about black smoke.

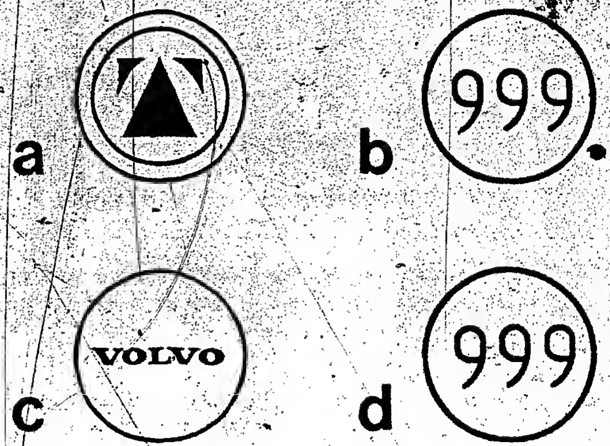
To remedy this fault, it is not necessary to remove the pump. It is sufficient to turn the full-load adjusting screw by 0.2 mm (approx. 1/4 turn) in a counterclockwise direction. The full-load adjusting screw should then be re-sealed with paint.

This work should be performed free of charge for the customer within the warranty period.

Motor Vehicle Service Information

BOSCH
Geschäftsbereich KH, Kundendienst Kraftfahrzeug-Ausrüstung
© by Robert Bosch GmbH, Postfach 50, D-7000 Stuttgart 1. Printed in the Federal Republic of Germany
Imprimé en République Fédérale d'Allemagne par Robert Bosch GmbH.

D23



Note:
If the full-load delivery has been reduced by the Volvo after-sales service, the full-load adjusting screw will have been provided with a black anti-tamper device (plastic cap) which is sealed with one of the lead seals shown above:

Sealed in	Front side	Back side
Sweden	"I" seal (Picture a)	Officially registered no. of inspection agency (Picture b)
Other countries	VOLVO emblem (Picture c)	Officially registered no. of inspection agency (Picture d)

Published by:
Robert Bosch GmbH
Division KH
Technical After-Sales Service (KH/VKD 2)
Please direct questions and comments concerning the contents to our authorized representative in your country.

1

Register tab 12 Vehicles
File
Identity VDT-I-VOL 027 En

VOLVO 240D, 740D AND 760TD

with distributor-type fuel-injection pump

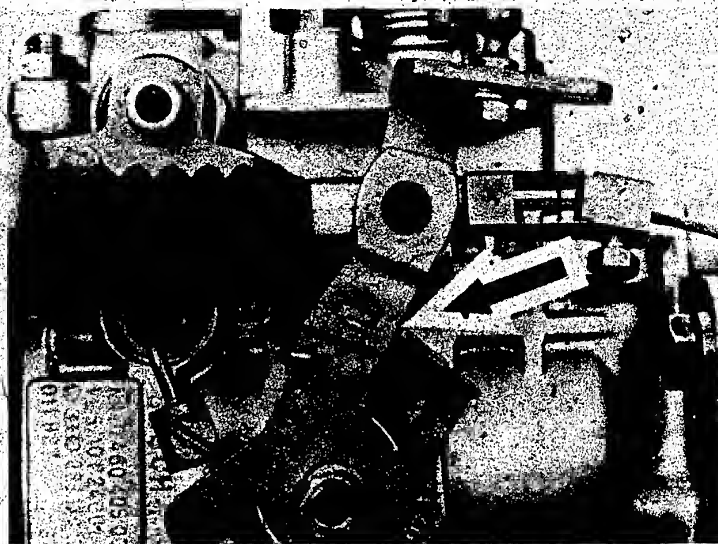
05.1986

Receiving inspections performed on returned fuel-injection pumps from the above-quoted vehicles (during the warranty period) have shown that, very often, the temperature-controlled idle increase (TLA) has been incorrectly set.

This incorrect setting results in very rough idling after cold-starting (at too low an idle speed). In addition, the engine may emit excessive blue smoke.

The cause is a change of the setting dimension of 12.7 mm measured between fulcrum lever and ball head of the TLA after the setting of the low idle speed.
If this dimension is not observed, there is a change in the increased idle speed.

To prevent the unprofitable removal of injection pumps in future, if the above-mentioned symptoms occur, first of all check the idle increase as described in the following.



1. Checking/adjusting the low idle speed

Connect tachometer (e.g. photoelectric) to engine.

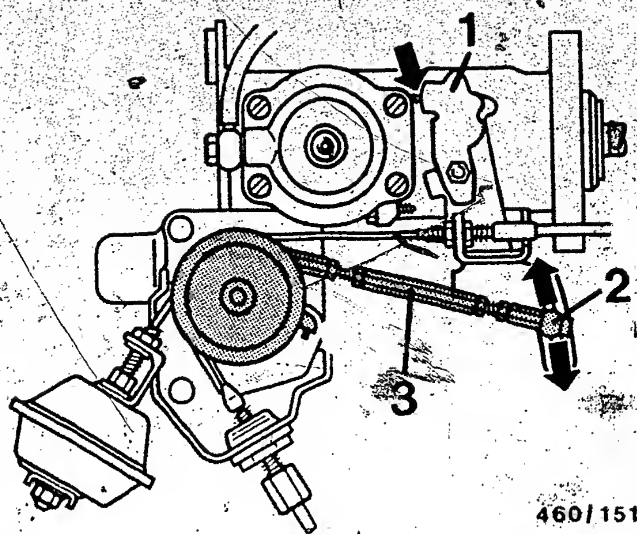
Start engine and run at idle speed.

Note:

To adjust the idle speed, the engine must be at normal operating temperature.

The control lever of the cold-start accelerator must be up against the stop bracket (arrow).

Coolant temperature approx. 80°C.

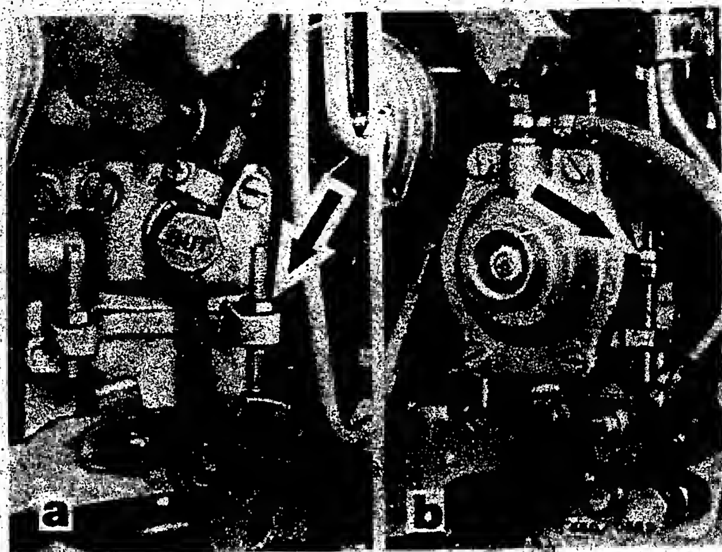


1 = Control lever
2 = Ball joint
3 = Connecting rod

For adjusting, the control lever of the injection pump must be up against the idle-stop screw of the pump (arrow).

Correct by changing the position of the ball joint or by turning the connecting rod.

After this correction, check the setting of the maximum-speed stop (reciprocal adjustment).



Picture a = Naturally aspirated engine (D20, D24)
Picture b = Turbo engine (D24T)

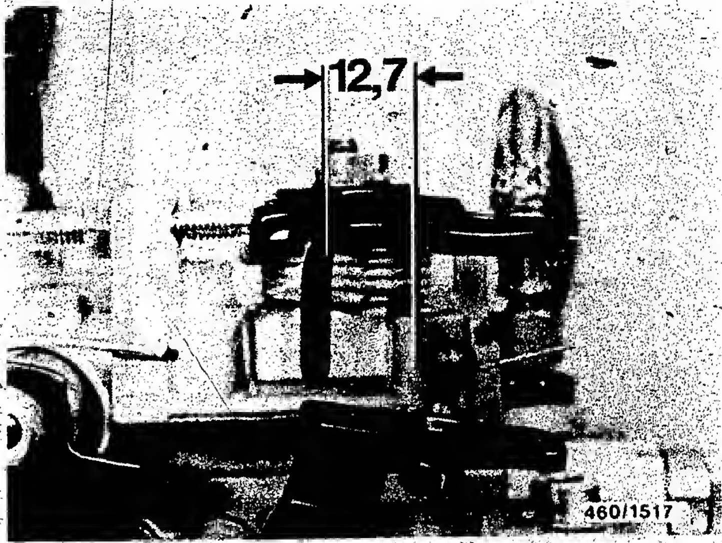
Set engine speed at idle-adjusting screw (arrow) to: #

D20, D24		750 min^{-1}	#
D24T	(-1984)	750 min^{-1}	#
D24T	(1985-)	830 min^{-1}	#

Note that the engine camshaft and injection pump are driven at half the engine speed.

After adjusting, lock and seal adjusting screw.

Remove tachometer and stop engine.



2. Checking/adjusting the temperature-controlled idle increase

Using caliper gauge, set distance between ball head and control lever to 12.7 mm.

Note:
Always perform this check whenever the low idle speed has been changed.

Published by:

Robert Bosch GmbH
Division KH
After-Sales Service Department for
Training and Technology (KH/VSK)

Please direct questions and comments concerning the contents to our authorized representative in your country.

VW DIESEL INDUSTRIAL ENGINES IM 068/2 — VDT-I-VWW 017 En

with VE..F.. — 10.1979

distributor-type fuel-injection pumps — Supersedes Ed. 4.79

On the VW diesel industrial engines, the VE..F..- distributor-type fuel-injection pump is fitted with a mechanical variable-speed governor and cold-start accelerator.

Engine data

Engines with 1.5 l swept volume as with the Golf (Rabbit) Diesel, but with reduced rated speeds of 4000 min^{-1}, 3600 min^{-1} and 3000 min^{-1}.

Engine with 1.6 l swept volume and rated speed of 3000 min^{-1}.

Fuel-injection equipment

Engine rated speed	Distributor-type injection pump	Model
1.5 l 4000 min^{-1}	0 460 494 010 - VE 4/9 F 2000 R 25	Works model with VW-Audi company sign and works-intern. No.
	0 460 494 011 - VE 4/9 F 2000 R 25 P	Trade model without VW-Audi company sign, oil-filled as protection against corrosion
1.5 l 3600 min^{-1}	0 460 494 012 - VE 4/9 F 1800 R 25-1	Works model with VW-Audi company sign and works-intern. No.
	0 460 494 013 - VE 4/9 F 1800 R 25-1 P	Trade model without VW-Audi company sign, oil-filled as protection against corrosion
1.5 l 3000 min^{-1}	0 460 494 035 VE 4/9 F 1500 R 25-3	Works model with VW-Audi company sign and works-intern. No.
	0 460 494 036 VE 4/9 F 1500 R 25-3 P	Trade model without VW-Audi company sign, oil-filled as protection against corrosion
1.6 l 3000 min^{-1}	0 460 494 017 - VE 4/9 F 1500 R 25-2	Works model with VW-Audi company sign and works-intern. No.
	0 460 494 018 - VE 4/9 F 1500 R 25-2 P	Trade model without VW-Audi company sign, oil-filled as protection against corrosion

BOSCH
Geschaftsbereich KH Kundendienst Kfz-Ausrüstung.
© by Robert Bosch GmbH, D-7 Stuttgart 1, Postfach 50 Printed in the Federal Republic of Germany
Imprimé en République Fédérale d'Allemagne par Robert Bosch GmbH.

E2

Fuel filter

Single-stage box-type filter	Model	Fuel-filter box
0 450 133 009 - FJ/DBR 1 W 6/3	Works model with water-trap chamber and drain screw, without hand pump	1 457 434 094

Nozzle-holder assembly

Nozzle-and-holder assembly
0 432 217 058 (works model)
0 432 217 059 (trade model)

Comprising:

Nozzle-holder assembly
0 430 211 041   KCA 305 D 27/4

Nozzle
0 434 250 063   DN 0 SD 193

Opening pressure 130^{+5} bar gauge pressure

See Microfiche for complete Bosch equipment.

Notes on after-sales service

After-sales service is carried out in the normal manner for the VE..F..-distributor-type injection pump. All testing and repair work on this pump will be done by Bosch after-sales-service workshops.

Exchange pump

The distributor-type injection pumps 0 460 494 011, .013 and .018 have been included in the exchange program with the Index 090.

Please make every effort to ensure that your workshop carries out impeccable and speedy repair work on the fuel-injection systems of these industrial engines.

Changes in settings

On these engines it can happen that the firm equipping the engines changes the settings of the distributor-type injection pump without making the appropriate modifications to the nameplate.

In order to prevent false settings during repair, the customer must be asked about changes in the settings when he delivers the pump.

If it impossible to ascertain exactly what changes have been made, then the pump can only be set using the Test Specifications issued by us.

In such cases, the manufacturer of the assembly of equipment is responsible for matching the pump to the equipment.

When the customer delivers such distributor-type injection pumps he is to be notified of these facts accordingly.

E3

1

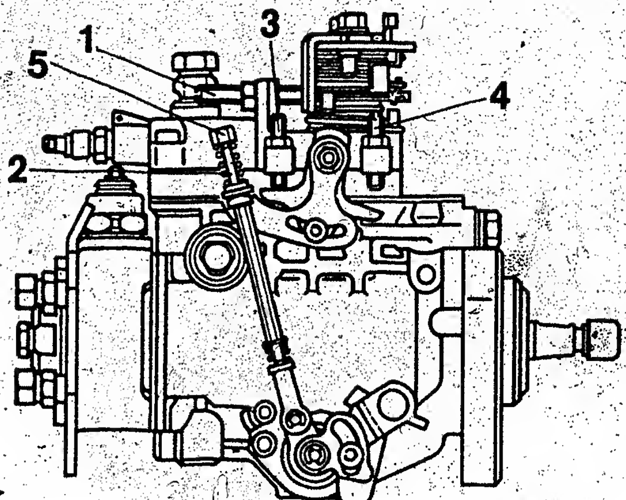
VW-Golf and Jetta - D

IDLE-SPEED INCREASE

ADJUSTMENT

To improve the operating conditions in the warm-up phase of the engine on the VW Golf and Jetta as of 1986 model year, a distributor-type fuel-injection pump with

- housing-rigid idle spring (LFG)
- idle speed increase coupled with KSB timing device has been installed.



460/1503

1 = Residual-delivery adjusting screw (previous idle-speed adjusting screw with anti-tamper cap must no longer be turned).
2 = Connecting rod for idle-speed adjustment
3 = Stop screw for low idle
4 = Stop screw for increased idle
5 = Cap nut

The idle speed is no longer adjusted at the previous idle-speed adjusting screw, but by turning the cap nut on the connecting rod.

Specification: 850 + 30 min^{-1}

- Turning the cap nut in a clockwise direction increases the speed
- Turning the cap nut in a counter-clockwise direction reduces the speed.

When the cold-start accelerator (KSB) is moved to stage 1 (pressure point is start of timing-device stroke), the idle speed rises by approx. 60 min^{-1}.

With the cold-start accelerator actuated all the way, the idle speed must rise to 1050 $\pm$ 50 min^{-1}.

If the idle speed cannot be adjusted or if the increased idle speed is incorrect, remove the distributor-type pump and perform basic setting of the idle on the test bench.

Published by:

Robert Bosch GmbH
Division KH
After-Sales Service Department for
Training and Technology (KH/VSK)

Please direct questions and comments concerning the contents to our authorized representative in your country.

40...46, 58
VDT-I-KFZ/1 En
11.1985
supersedes Ed. 01.1985
VDT-I-Gen. 071

NEW SYSTEM

EGR SYSTEMS FOR PASSENGER-CAR DIESEL ENGINES

The following deals with electronically/pneumatically controlled exhaust-gas recirculation systems (EGR systems) for passenger-car diesel engines. Such systems are already used in US-model vehicles.

* EGR depending on a mechanical-pneumatic pressure transducer (BMW) 524 td).

* EGR depending on air flow and duration-of-injection signal (Peugeot 505 Turbo-Diesel).

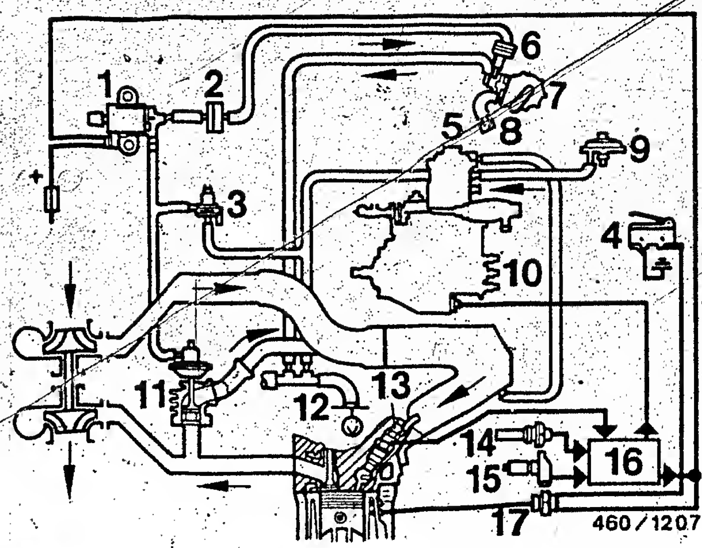
* EGR depending on a control-rod-travel (load) signal (Mercedes-Benz 300 SD Turbo-Diesel).

In order to improve the exhaust-gas emissions and to comply with the existing regulations as well as those to be expected in the future, more and more diesel-engined vehicles are being equipped with exhaust-gas recirculation (EGR).

The partial afterburning of the recirculated exhaust gases lowers the combustion temperature and reduces the emission of oxides of nitrogen (NO_x).

The EGR operates in the idle and part-load ranges of the engine. No exhaust gas is recirculated when the engine is cold.

Motor Vehicle Service Information



Exhaust-gas recirculation (EGR) with pressure transducer

1 = Change-over valve
2 = Restriction
3 = ALDA air-admission valve
4 = Microswitch
5 = ALDA
6 = Damper
7 = Pressure transducer
8 = Filter
9 = Reference-pressure unit
10 = Timing valve
11 = EGR valve
12 = Vacuum pump (engine)
13 = Needle-movement sensor
14 = Temperature sensor
15 = Engine-speed sensor
16 = Control unit
17 = Temperature sensor

Operating principle of EGR with pressure transducer

A portion of the exhaust gas is recirculated to the charge-air pipe through a vacuum-controlled EGR valve (11).

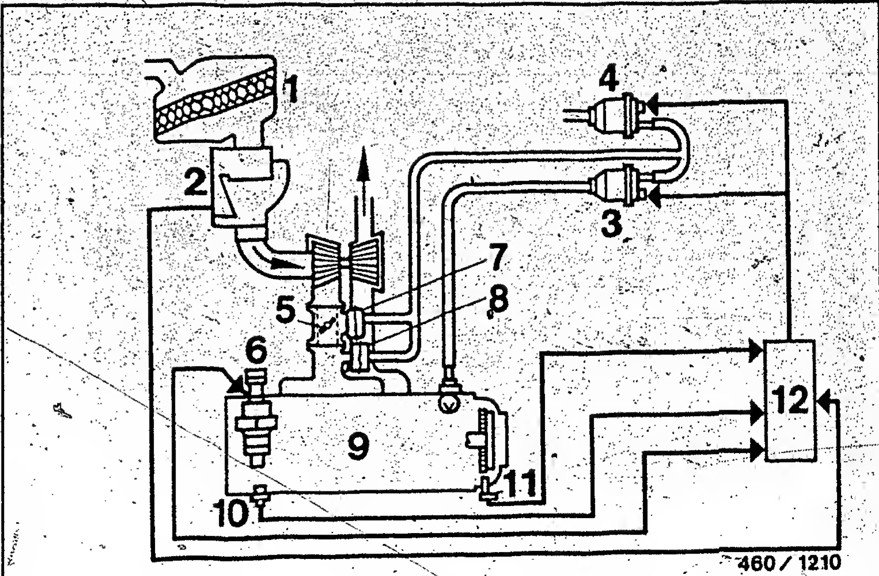
The EGR rate is adapted to the injected-fuel-quantity characteristic by means of the continuous changing of the control vacuum in a mechanical-pneumatic pressure transducer (7).

This pressure transducer is connected to the injection-pump control lever by means of a connecting rod and is fixed in a specified position with respect to the pump.

The operating range of the EGR system is limited to the operating modes "idle" and "part load" by means of an electropneumatic change-over valve (1).

The change-over valve is energized at idle by a closed microswitch (4) and it is energized at part load within a specified engine-speed range by the control unit (16).

When the engine is cold, the EGR is switched off by temperature sensors 14 and 17.



Exhaust-gas recirculation with duration-of-injection signal

1 = Air filter
2 = Air-flow sensor
3 = Solenoid-operated valve (vacuum)
4 = Solenoid-operated valve (atmosphere)
5 = Throttle valve
6 = Injection nozzle with needle-movement sensor
7 = Throttle-valve vacuum unit
8 = EGR valve
9 = Vacuum pump (engine)
10 = Temperature sensor
11 = Engine-speed sensor
12 = Control unit

E10

Operating principle of EGR with duration-of-injection signal

With this EGR system, the quantity of exhaust gas drawn in by the engine is controlled indirectly as a function of engine load and engine speed by measuring the fresh-air flow.

Signal measuring

A flap-type air-flow sensor (2) with potentiometer sensor measures the instantaneous value of the inducted fresh-air flow.

The load signal is picked off representatively for all other injection nozzles of the engine at a nozzle holder (6) in which a needle-movement sensor is integrated. The duration of injection is taken as a measure of the injected fuel quantity.

The engine speed is measured by an inductive sensor (11) with which the teeth of the flywheel ring gear are sensed.

A temperature sensor (10) measures the cooling-water temperature and switches the EGR off at temperatures below its switching threshold.

Signal processing

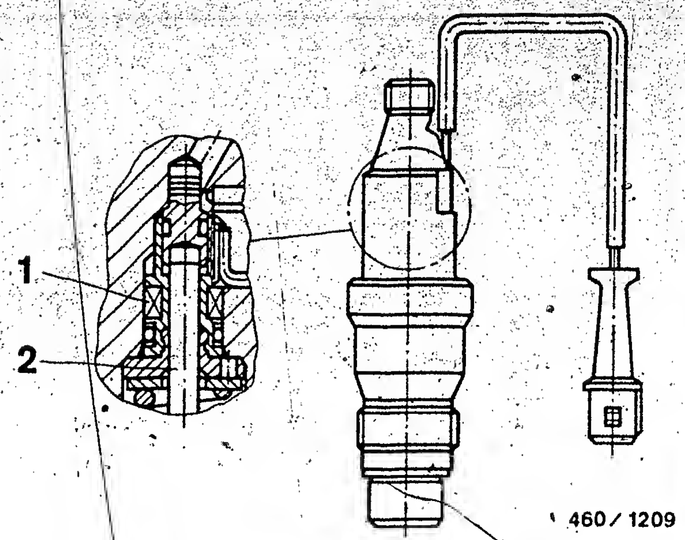
In addition to various characteristics for internal signal processing, two important characteristics/maps are stored in the control unit: the duration-of-injection/injected-fuel quantity map and the lambda characteristic with engine-speed correction.

The engine demand is thus precisely determined and the injected quantity is correctly metered by the injection system.

Duration of injection and engine speed are, therefore, the decisive parameters from which the control unit calculates a setpoint for the air-flow sensor voltage and compares it with the instantaneous fresh-air flow.

Possible deviations are detected by a 3-point controller (installed in the control unit). This controller alternately energizes two electropneumatic valves (atmosphere/vacuum) until the correct EGR flow (taken from the map) has been set by appropriate adjustment of the EGR valve and of the throttle-valve assembly.

In order not to negatively influence the load signal in the case of non-carbon-fouled nozzles (shorter duration of injection for same injected-fuel quantity than in case of carbon-fouled nozzles), the injection cycles are added up in a digital running-time module and, after the max. counter reading has been reached, they are gradually reduced by a correction amount in order to compensate.



1 = Needle-movement sensor
2 = Pressure spindle

Operating principle of injection nozzle with needle-movement sensor

DC is applied and regulated such that a constant current flows which is independent of temperature.

There is a gap in the magnetic circuit of the needle-movement sensor. The pressure spindle (2) changes this gap, which in turn leads to a change in the magnetic flux and a change in the signal voltage induced in the coil.

The amplitude of the signal voltage is proportional to the rate of change of the magnetic flux, which itself is determined by the velocity with which the pressure spindle moves and by the geometrical conditions in the gap.

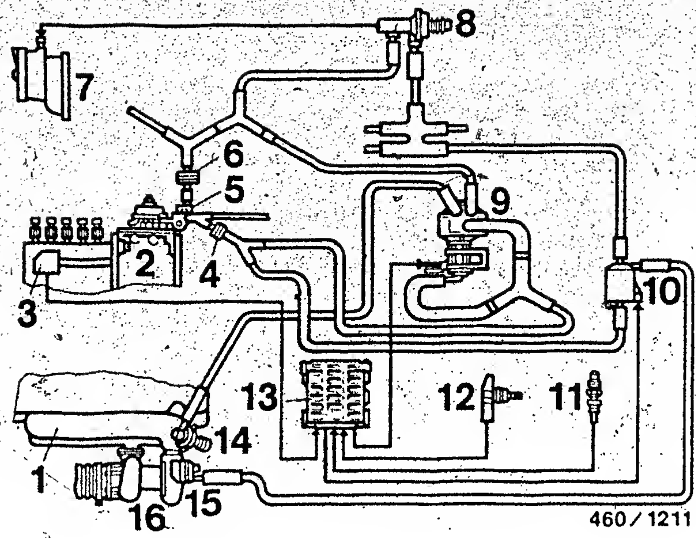
The signal characteristic is substantially influenced by the sensor gap.

The decisive factors are:

- Holder
- Adjusting pin
- Pressure spindle
- Intermediate disc
- Nozzle

A change in the nozzle components leads to a change in the sensor gap and, therefore, to a change in the signal voltage. This causes incorrect evaluation by the control unit.

For this reason, only the opening pressure may be changed during after-sales service. If the nozzle is defective, the complete nozzle-holder assembly must be replaced.



Exhaust-gas recirculation with control-rod-travel sensor

1 = Intake manifold
2 = Fuel-injection pump
3 = Control-rod-travel sensor
4 = Air-admission filter
5 = Vacuum-control valve
6 = Vacuum damper
7 = Vacuum pump (engine)
8 = Non-return valve
9 = Pressure transducer
10 = Change-over valve
11 = Temperature sensor
12 = Engine-speed sensor
13 = Control unit
14 = EGR valve
15 = Bypass-air safety valve
16 = Exhaust-gas turbocharger

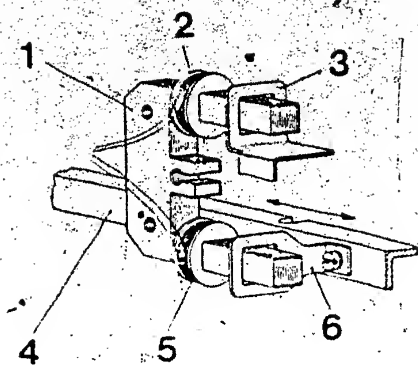
Operating principle of EGR with control-rod-travel sensor

The vacuum generated by a vacuum pump (7) is transformed by the pressure transducer (9) into a load-dependent vacuum signal which is used to control the EGR valve (14).

Depending upon the load condition of the engine, a change-over valve (10) applies additional vacuum to a bypass-air safety valve (15) in the part-load range.

The charge-air pressure is thus partially reduced and the EGR rate is increased.

The control unit processes the input signals for control-rod travel, engine speed and engine temperature, and from the resulting signal controls the pressure transducer and the change-over valve.



460/1212

1 = Laminated iron core
2 = Reference coil
3 = Fixed short-circuit ring
4 = Control rod
5 = Measuring coil
6 = Movable short-circuit ring

Operating principle of control-rod-travel sensor

A reference inductance is formed by the reference coil (2) and the fixed short-circuit ring (3).
Depending on the position of the control rod (4), the distance between the movable short-circuit ring (6) and the measuring coil (5) is changed.
The resulting change in inductance is measured and from it the control unit calculates a control-rod-travel (load) signal.

Published by:
Robert Bosch GmbH
Division KH
After-Sales Service Department for Training and Technology (KH(VSK)
Please direct questions and comments concerning the contents to our authorized representative in your country.

New Product | 40...46, 58
START-OF-DELIVERY SENSOR SYSTEM | VDT-I-413/1 En
for dynamic start-of-delivery testing | 8.1984
on in-line injection pumps | supersedes Ed. 4.1983

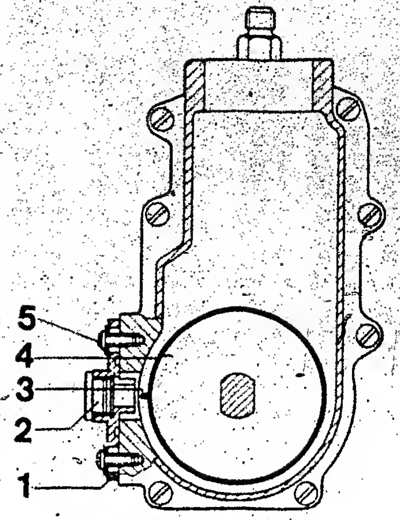
The timing of in-line injection pumps to the engine and the testing of the static start of delivery have so far been performed with the aid of the hydraulic overflow method by way of pointer and mark.
To simplify this usually elaborate series of operations, a measuring device has been developed for governor types RW.. and RSF.. . This device permits the following setting and testing methods:

- Locking the injection-pump camshaft with cylinder 1 in start-of-delivery position for mounting on the engine.
- Testing of the start of delivery with the engine running in order to guarantee precise, optimum timing of pump to engine.
- Possibility of measuring timing device operation as a function of engine speed.

This new method is used for the first time on Daimler-Benz passenger cars and is called start of delivery sensor system. At Daimler-Benz it is also referred to as RIV = governor pulse method.

Technical Bulletin

BOSCH Geschäftsbereich KH, Kundendienst Kraftfahrzeug-Ausrüstung
© by Robert Bosch GmbH, Postfach 50, D-7000 Stuttgart 1. Printed in the Federal Republic of Germany.
Imprimé en République Fédérale d'Allemagne par Robert Bosch GmbH



1 = Sliding flange
2 = Screw plug
3 = Lug (signal position)
4 = Flyweight capsule
5 = Tear-off screw M6

Construction and principle of operation

To measure the timing of the injection pump to the engine, two signals are necessary:

- TDC pulse from engine crankshaft
- governor pulse from injection pump (lug on flyweight).

The MW injection pump with RW governor has been provided on the outside of the governor housing with a sliding flange (1) with mounting bore for a holding device and/or for an inductive pulse generator (screw plug (2) not a Bosch part). In addition, the flyweight capsule (4) of the governor has been provided with a lug (3) for signal triggering.

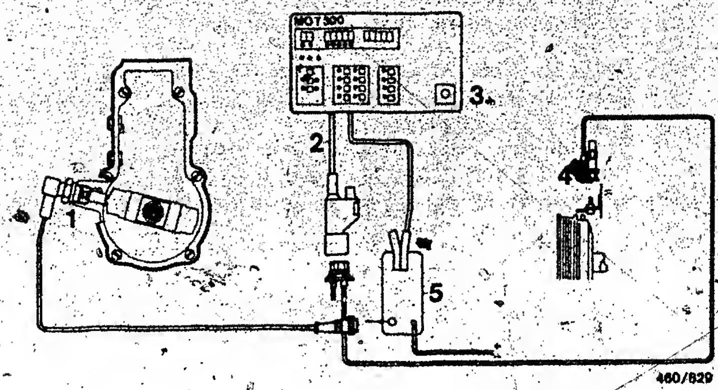
The signals are generated when the signal triggering devices (lug on flyweight part and TDC sensor pin on crankshaft flywheel) move past the inductive generators at a minimum speed (idle). A measuring instrument measures the time gap between the two pulses and converts the result into an angle which is then indicated.

Division K7 will soon be offering a suitable ballast unit for motortesters for this dynamic start-of-delivery setting procedure.
In addition, the diesel tester ETD 019.00, Part No. 0 684 101 900 which has been newly included in the sales program by K7 can also be used for this setting method.

Injection timing and dynamic start-of-delivery testing

Turn engine crankshaft to correct position in accordance with setting instructions.
Insert injection pump in engine flange with holding device KDEP 1077.
Note:
Danger of damage to injection pump.
Immediately after installing the injection pump (fastening screws tightened) remove holding device KDEP 1077 and replace with screw plug.

Connect motortester with ballast unit or diesel tester in accordance with connection diagram and perform dynamic test.
See respective vehicle-related SIS microfiches for test specifications and setting values.



Connection diagram for dynamic start-of-delivery testing with ballast unit and motortester (e.g. MOT 300).

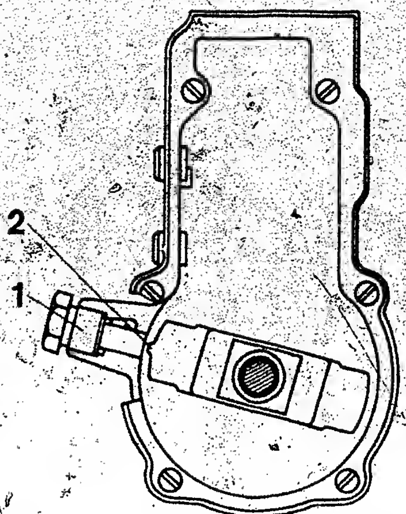
1 = Governor pulse generator
    Daimler-Benz Part No. 617 579 102 100

2 = Adapter lead
    Bosch Part No. 1 684 463 094

3 = Motortester MOT 300
    Bosch Part No. 0 684 000 300

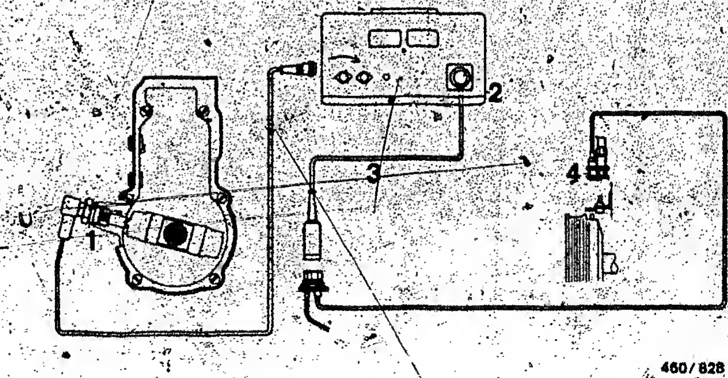
4 = TDC pickup
    Bosch Part No. not yet specified

5 = Ballast unit
    Bosch Part No. not yet specified



1 = Screw plug
2 = Lug (signal position)

The M.. injection pump with RSF II governor does not have a sliding flange on the governor housing. The mounting bore for the pulse generator/holding device has been incorporated in the housing.
There is a lug (2) directly on the flyweight for signal triggering.



Connection diagram for dynamic start-of-delivery testing with diesel engine tester ETD 019

1 = Governor pulse generator
    Daimler-Benz — Part No. 617 579 102 100
2 = Diesel engine tester ETD 019.00
    Bosch — Part No. 0 684 101 900
3 = Adapter lead
    Bosch — Part No. 1 684 463 147
4 = TDC pickup
    Daimler-Benz — Part No. 601 589 042 100

Published by:

Robert Bosch GmbH
Division KH
After-Sales Service for Training and Technology (KH/VSK)

Please direct questions and comments concerning the contents to our authorized representative in your country.

DISTRIBUTOR-TYPE FUEL-INJECTION PUMP
VE..L32/..L116 FOR VOLVO PASSENGER CARS
MODEL 240 SERIES D 6 AND MODEL 760
Complaints Because of Black Smoke

VDT-I-460/140 En
7.1985

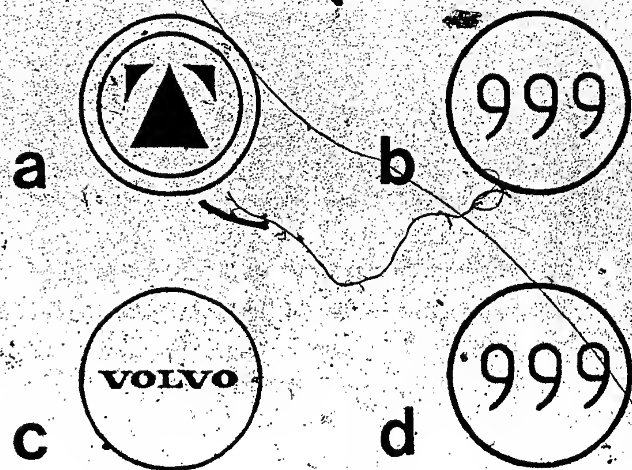
An increase in the fuel delivery of approx. 2 ... 3 cm³/ 1000 strokes may lead with the above-mentioned distributor-type fuel-injection pumps for these vehicles to complaints because of black smoke.

To remedy this fault, it is not necessary to remove the pump. It is sufficient to turn the full-load adjusting screw 0.2 mm (approx. 1/4 turn) in a counterclockwise direction. The full-load adjusting screw should then be re-sealed with paint.

This work is to be performed free of charge for the customer within the warranty period.

Technical Bulletin

BOSCH Geschäftsbereich KH, Kundendienst Kraftfahrzeug-Ausrüstung



Note:

If the full-load delivery has been reduced by the Volvo after-sales service, the full-load adjusting screw will have been provided with a black anti-tamper device (plastic cap) which is sealed with one of the above-shown lead seals:

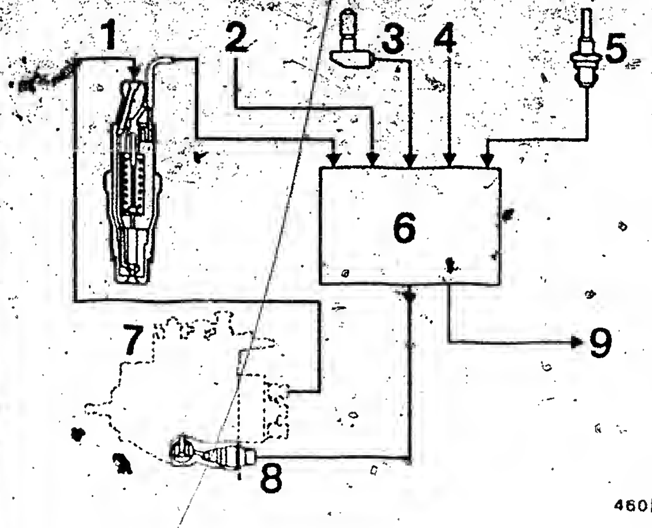
Sealed in	Front side	Rear side
Sweden	"T" seal (Picture a)	Officially registered no. of test agency (Picture b)
Other countries	VOLVO emblem (Picture c)	Officially registered no. of test agency (Picture d)

Published by:
Robert Bosch GmbH
Division KH
Technical After-Sales Service (KH/VDK 2)
Please direct questions and comments concerning the contents to our authorized representative in your country.

Technical Bulletin

NEW SYSTEM
ELECTRONIC CLOSED-LOOP START-OF-INJECTION CONTROL ON DIESEL ENGINES WITH DISTRIBUTOR-TYPE INJECTION PUMP

Register tab 7 Systems
File Identity VDT-I-KFZ / 4 En
02.1986



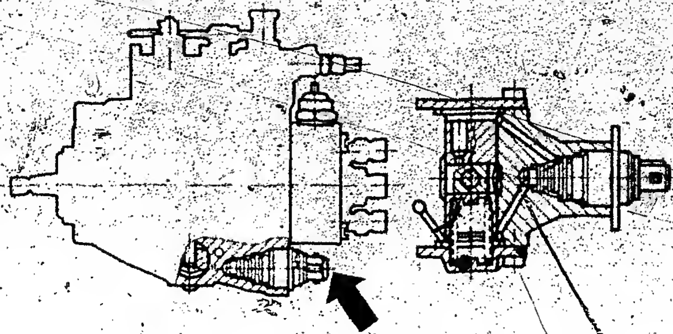
1 = Needle-lift sensor for start-of-injection measurement
2 = Load-dependent signal
3 = Engine-speed and TDC sensor
4 = Altitude-dependent signal
5 = Water-temperature sensor
6 = Control unit
7 = Fuel-injection pump
8 = Solenoid-operated valve
9 = [illegible]t message (diagnosis)

System diagram of electronic closed-loop start-of-injection control

The start of injection is one of the main influencing parameters regarding the operating performance and combustion in the diesel engine. Starting, noise, fuel consumption and emissions are decisively influenced by the start of injection.

To comply with emission limits, fuel consumption and optimized comfort, it is necessary to have fuel-injection systems that guarantee high flexibility of governing as well as the possibility of processing additional parameters with small tolerances and high accuracy, throughout the service life.

These requirements are met by the electronic closed-loop start-of-injection control system. Compared with mechanical systems, electronic measuring, data processing and the closed loop with electrical actuator (solenoid-operated valve) result in improved and new governing functions.



460 / 1208

The basic construction and operating principle of the distributor-type injection pump with electrically energized timing device are the same as in the mechanically governed injection pump.

The quantity of fuel injected is controlled by a mechanical centrifugal-force governor.

The solenoid-operated valve is installed in a protected location on the underside of the injection pump (arrow) without considerably changing the outer contours of the injection pump in the area of the timing device.

The electronic closed-loop start-of-injection control system can be broken down into three central blocks:

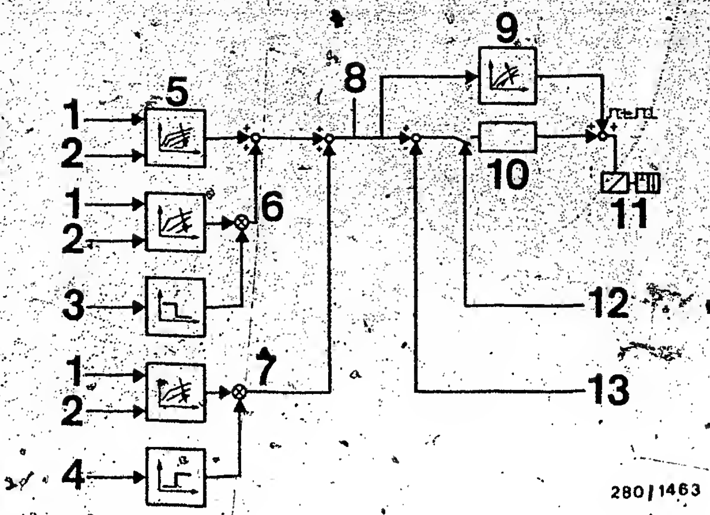
* Sensors (e.g. needle-lift sensor, engine-speed/TDC sensor and water-temperature sensor)
  The sensors detect the operating conditions and convert the physical quantities into electrical signals.
* Control unit with microprocessor
  The control unit processes the information in accordance with a preset internal evaluation system and supplies electrical output signals.
* Actuator (solenoid-operated valve)
  The actuator converts the electrical output signals from the control unit into mechanical quantities.

Sensors

The start of injection is detected by a sensor which is integrated into the nozzle holder and which tells when fuel is injected by detecting the needle lift.

A common engine-speed sensor is used for measuring the engine speed and for detecting top dead center (TDC) or a reference signal.
This sensor detects marks which are attached to the crankshaft flywheel in addition to the starting-motor ring gear according to the number of engine cylinders.

The air pressure and coolant temperature are measured by sensors which are characterized by a high measuring accuracy and long-term stability.



Block diagram of electronic closed-loop start-of-injection control

1 = Engine-speed signal
2 = Temperature signal
3 = Atmospheric pressure
4 = Engine torque
5 = Maps
6 = Altitude compensation
7 = Load correction
8 = Optimized start of injection
9 = Preset map
10 = PI controller
11 = Solenoid-operated valve
12 = Switched by control unit
13 = Actual start of injection

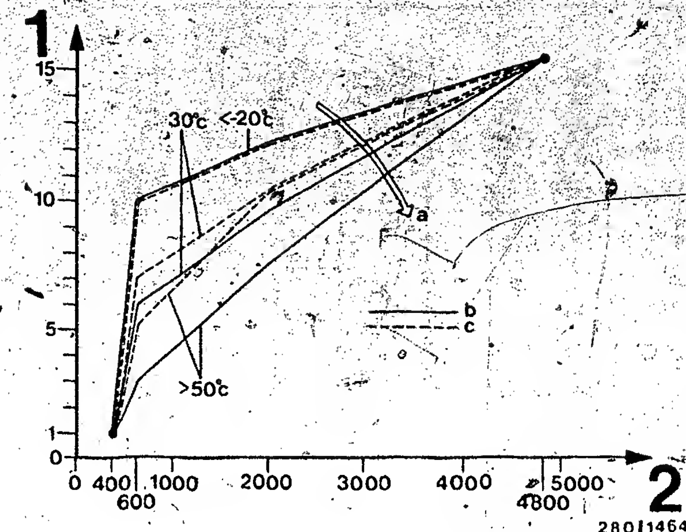
Control unit

The electronic control unit is of digital design. The microprocessor contains memory units (maps) with start-of-injection setpoints as a function of:

* Load
* Engine speed
* Coolant temperature
* Altitude

The circuitry is completed by devices for converting the sensor signals into computer-compatible quantities.

F2



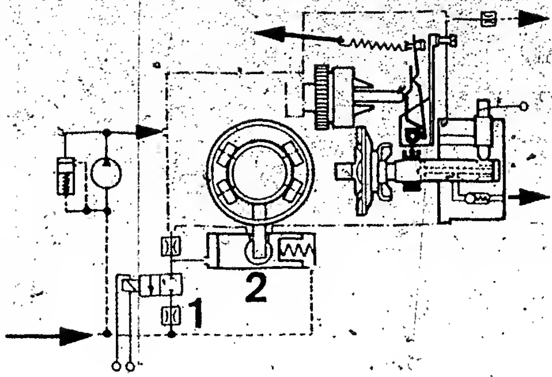
Start-of-injection map, parameters of engine load and coolant temperature

1 = Start of injection in °crankshaft before TDC
2 = Engine speed (min^{-1})

a = Water temperature
b = No-load
c = Full load

Note:

The graph shows an example of a load-dependent start-of-injection map for various coolant temperatures.

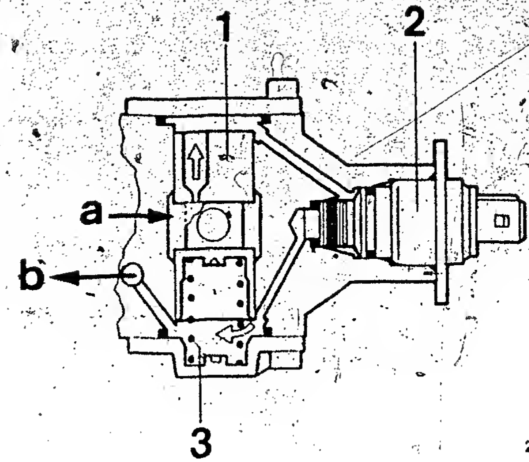


280/1465

1 = Solenoid-op. valve   2 = Timing device
Distributor-type injection pump with electronically energized timing device.

Governing

Thanks to the closed control loop, the actual start of injection, which is measured directly at the injection nozzle, is compared with the programmed start-of-injection setpoint in the control unit.
If there is any deviation, the solenoid-operated valve on the timing device is energized. The on/off ratio is changed until the deviation is zero.
Through this pulsing of the solenoid-operated valve, the actuating pressure at the timing-device piston is modulated and is superimposed on the basic mechanical timing.
This ensures the same dynamic performance as with mechanical start-of-injection timing and also guarantees operation should the electronics fail.



1 = Timing-device piston
2 = Solenoid-operated valve
3 = Timing-device spring

a = Pump interior pressure
b = Pump inlet pressure (= Supply-pump intake pressure).

Solenoid-operated valve

The rpm-proportional pump interior pressure is applied to the timing-device piston.

With the solenoid-operated valve permanently open (pressure reduction), there are late starts of injection; with the valve fully closed (pressure increase) there are early starts of injection. Between these extremes the on/off ratio (ratio of open time to closed time of the solenoid-operated valve) can be constantly varied by the control unit.

Limp-home functions

Should the needle-lift sensor fail, there is a switch from closed-loop to open-loop mode.

If the engine-speed sensor fails, a substitute engine-speed signal is established from the time interval between the start-of-injection signals from the needle-lift sensor.

If both sensors fail, fixed input data are specified for the maps.

Service

To provide rapid detection of malfunctions, the control unit is equipped with a self-diagnosis feature, with which defective components are identified by a fixed flashing code.

Published by:

Robert Bosch GmbH
Division KH
After-Sales Service Department for
Training and Technology (KH/VSK)

Please direct questions and comments concerning the contents to our authorized representative in your country.

F6

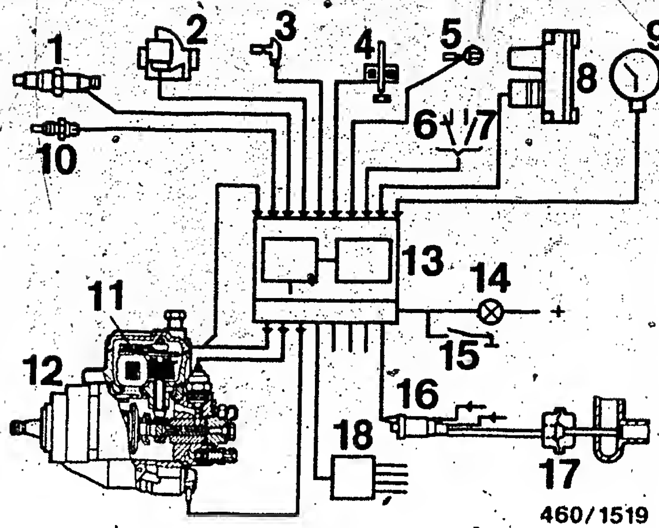
115

NEW SYSTEM	Register tab 7	Systems
ELECTR.-CONTROLLED DIESEL	File Identity	VDT-I-KFZ / 6 En
FUEL INJECTION WITH DISTRIBUTOR		06.1986

FUEL-INJECTION PUMP

For several years, the requirements placed on diesel-fuel-injection systems with regard to emissions, fuel consumption, and comfort have been steadily rising. This necessitates systems having high flexibility of control, as well as providing the possibility of processing additional actuating variables with low tolerances and high exactitude, throughout their service lives.

These requirements are fulfilled by fully-electronically-controlled diesel fuel injection (EDC = Electronic Diesel Control). As compared with mechanical systems, electronic measurement, data processing, and the closed control loop using electrical and electro-pneumatic actuators provide new control functions and improve existing ones.



1 = Nozzle holder with needle-motion sensor
2 = Air-flow sensor with air-temperature sensor
3 = Engine-speed reference-mark sensor
4 = Speed sensor
5 = Cruise-control operating lever
6 = Clutch switch
7 = Brake switch
8 = Manifold/atmospheric-pressure sensor
9 = Accelerator-pedal sensor
10 = Water-temperature sensor
11 = Fuel-temperature sensor
12 = Fuel-injection plug
13 = Control unit
14 = Diagnostic display
15 = Blink-code request button
16 = Electro-pneumatic pressure transducer or control valve
17 = EGR valve
18 = Glow-time control unit

Components of the electronic diesel fuel-injection system.

1- KF216

Improved and New Functions

Improvements:

Key start/stop
Choice of torque characteristic
Performance characteristic,
Load-independent idle speed
Cold-start acceleration
Smoke limitation
Pre-heating system control
Tamper proof
Exhaust-gas recirculation control
Cruise control

New functions:

Maximum engine speed limitation
Temperature-dependent full-load delivery
Temperature-dependent starting fuel delivery
Start-of-injection control
Active anti-bucking
"Electronic accelerator pedal"
(no mechanical linkage)

Possible outputs:
- Injection quantity signal
- Engine-speed signal
- Diagnosis

Limited adaptation through software alteration, reduced number of injection-comp variants resulting in reduced stocking.

Electronic diesel fuel injection is divided into three central system blocks:

* <u>Sensors</u>
  (e.g. needle-motion sensor, engine-speed reference-mark sensor, water-temperature sensor, etc.)
  The sensors determine operating conditions and convert physical values into electrical signals.

* <u>Control unit with microprocessor</u>
  The EDC system works with two control units. These control units process the sensor data according to certain internal evaluation criteria and generate electrical output signals.

* <u>Actuators</u>
  The actuators convert the electrical output signals from the control unit into mechanical quantities.

<u>Sensors</u>

Accelerator-pedal position, injection-pump control-rod position, and air flow are determined by potentiometers, and engine speed and start of injection by inductive pickups.

Resistance sensors measure pressure and temperature, and are noted for their extreme accuracy and long-term consistency.

Start of injection is determined by a sensor integrated in the nozzle holder which determines the moment of fuel injection by recognising needle motion.
A common engine-speed sensor is used to determine engine speed and to register a reference signal.
This sensor recognises marks made on the crank shaft fly wheel in addition to the starting-motor ring gear.
These marks correspond to the number of engine cylinders.

Control unit

The electronic control units are constructed using digital technology. They contain microprocessors, memory units (characteristic maps/characteristic curves) with nominal values depending on:

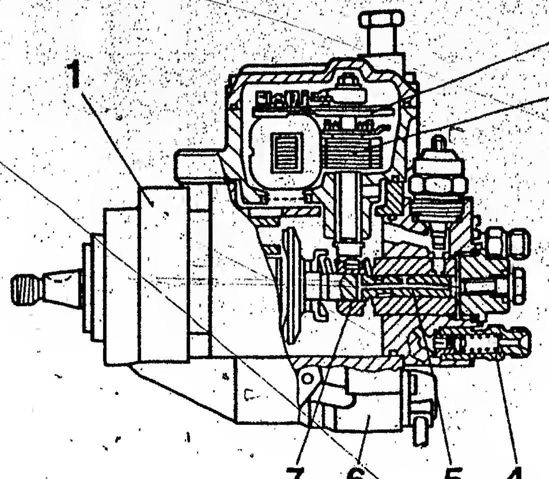
* Engine speed
* Temperatures
* Fuel delivery

Devices for the conversion of sensor signals into computer-standard values complete the circuitry.

Actuators

Separate actuators are required for injection quantity, start of injection, and exhaust-gas recirculation. The actuators for injection quantity and start of injection are integrated in the injection pump.
A rotary-magnet actuator directly affects the mechanical control of injected fuel quantity (control spool) via a shaft. The rotary motion is converted into a linear motion on the part of the control spool via an eccentrically-arranged driving pin. The control spool opens the cutoff cross sections depending on position, just as with the mechanically-controlled pump.

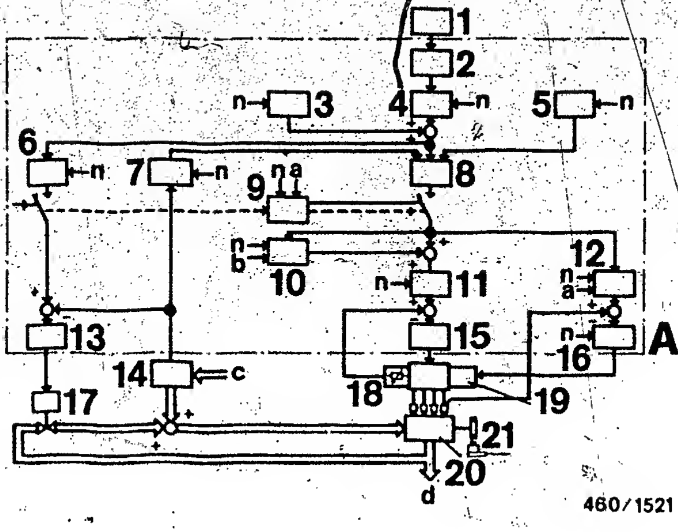
For actuation of start of injection, the pressure at the timing-device piston is modulated via a clocked solenoid-operated valve. When the solenoid valve is continuously open (pressure reduction), injection starts are late, while a fully-closed valve (pressure increase) results in early injection starts. The on-off ratio (ratio of opened to closed time of the solenoid-operated valve) can be continuously varied between these extremes by the control unit.



1 = Distributor-type fuel-injection pump for electronically-controlled diesel fuel injection
2 = Control-spool travel sensor
3 = Actuator for injection quantity
4 = Delivery-valve holder
5 = Supply plunger
6 = Solenoid-operated valve for start of injection
7 = Control spool

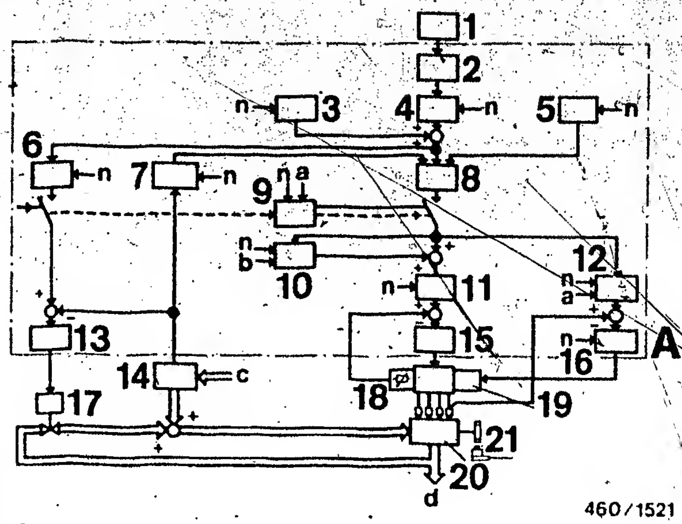
The exhaust-gas recirculation actuator (electro-pneumatic pressure transducer or control valve) is triggered with current impulses of differing lengths via the EGR regulator (in the control unit). The actuator thereby modulates the vacuum pressure present and triggers the EGR valve, resulting in an adaptation of the rate of exhaust-gas recirculation to the fuel-delivery quantity and engine speed.

When using open-loop-controlled exhaust-gas recirculation without feedback from the air-flow sensor, the EDC triggers the EGR valve depending on injected fuel quantity and engine speed.



1 = Accelerator pedal
2 = Rise limitation
3 = Lower-idle-speed control
4 = Accelerator-pedal characteristic map
5 = Full-load characteristic curve
6 = EGR characteristic map
7 = Smoke characteristic map
8 = Lowest-value selection
9 = Starting control
10 = Fuel-temperature correction
11 = Pump characteristic map
a = Engine temperature
b = Fuel temperature
c = Air
d = Exhaust
n = Engine speed
A = Contents of control units 1 and 2
Control unit 1 = Fuel-delivery and cruise control
Control unit 2 = Start of injection and exhaust-gas recirculation control, and diagnostic output.

Block diagram of electronic diesel fuel-injection control



460/1521

12 = Start-of-injection characteristic map
13 = EGR control
14 = Air-flow sensor
15 = Actuation regulator
16 = Start-of-injection regulator
17 = EGR actuator
18 = Pump with feedback
19 = Timing device
20 = Engine
21 = Engine-speed/reference-mark sensor
a = Engine temperature
b = Fuel temperature
c = Air
d = Exhaust
n = Engine speed
A = Contents of control units 1 and 2
Control unit 1 = Fuel delivery and cruise control
Control unit 2 = Start of injection and exhaust-gas recirculation control, and diagnostic output.

Block diagram of electronic diesel fuel-injection control (continued)

Closed-loop injection-quantity control

Starting, idle, performance, and soot emission are definitively influenced by the fuel-injection quantity. Consequently, a temperature-dependent starting-quantity characteristic map, low-idle-speed control, a performance characteristic map, and an air-flow-dependent full-load characteristic curve are programmed in.

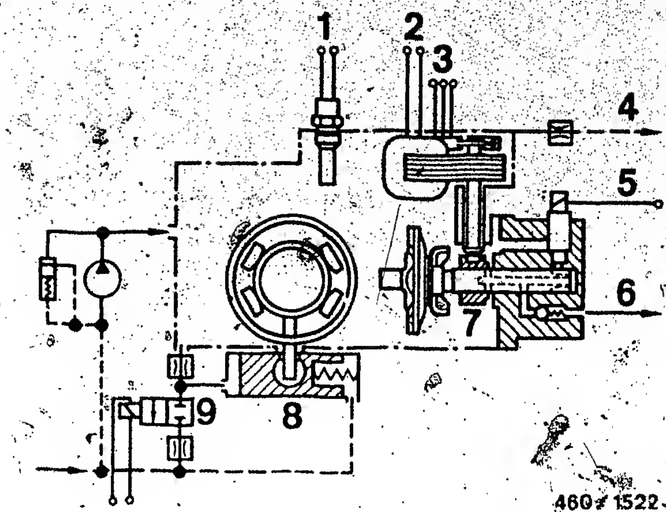
The driver's desired torque is specified via an accelerator sensor. In the control unit, a specified value for the position of the injection-quantity actuator is determined based on a certain control response and under consideration of the map values stored in memory. A closed actuation loop with feedback to the pump monitors the correct setting of the control spool of the injection pump.

Closed-loop start-of-injection control

Starting, noise levels, fuel consumption, and emissions are definitively influenced by start of injection.

A characteristic start-of-injection map is programmed in which takes into account these dependencies. The extreme accuracy of start of injection is guaranteed by a closed control loop. For this purpose, the actual start of delivery is determined directly at the nozzle with a needle-motion sensor and compared with the programmed nominal start of injection. Any deviation results in an actuation of the solenoid-operated valve at the timing device. The on-off ratio is altered until the control deviation = nil.

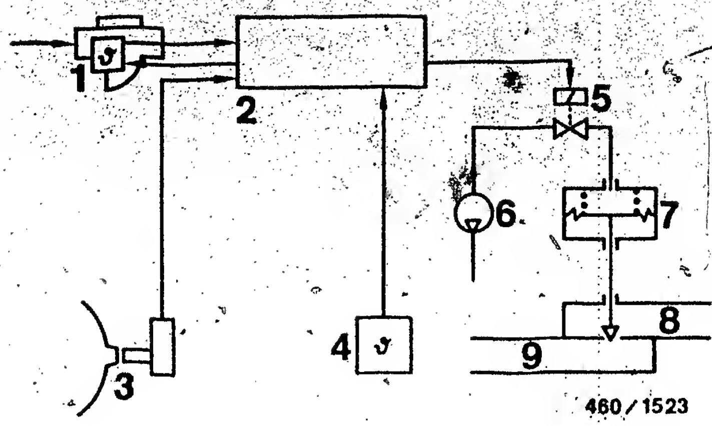
Actuation pressure at the timing-device piston is modulated via this clocked solenoid-operated valve.



1 = Fuel-temperature sensor
2 = Fuel-delivery actuator
3 = Control-spool-travel sensor
4 = Overflow
5 = ELAB
6 = To injection nozzle
7 = Control spool
8 = Timing device
9 = Solenoid-operated valve.

Schematic diagram of the distributor-type fuel-injection pump.

1-KF216



1 = Air-flow sensor with air-temperature sensor
2 = Control unit
3 = Engine-speed sensor
4 = Coolant-temperature sensor
5 = Exhaust-gas recirculation actuator
6 = Engine vacuum pump
7 = Exhaust-gas-recirculation valve
8 = Charge-air pipe
9 = Exhaust pipe

Block diagram of closed-loop-controlled exhaust-gas recirculation.

Exhaust-gas-recirculation closed-loop control

Exhaust-gas recirculation is used to reduce emissions. The exhaust-gas quantity inducted by the engine is indirectly controlled in a closed control loop via the determination of the outside-air quantity in dependence on engine loading and engine speed. An EGR map is programmed into the control unit for this purpose. The actual value of outside air determined by an air-flow sensor is compared with the programmed nominal value. Any deviations are detected by a continuous regulator (built into the control unit).

This regulator actuates the electro-pneumatic pressure modulator (EGR actuator) until the corresponding setting of the EGR valve results in the correct exhaust-gas-recirculation quantity as indicated by the characteristic map.

Limp-home functions

The EDC system is self-monitoring. Computing functions as well as sensor operations are monitored. Upon malfunction on the part of sensors or components, appropriate safety or limp-home functions can be initiated.

Malfunction/limp-home measure

1. Delivery-quantity actuator defective:
   Engine is switched off via ELAB
2. Timing device defective:
   Fuel delivery is limited.
3. Air-flow sensor defective:
   Set value for air quantity, no exhaust-gas recirculation.
4. Exhaust-gas-recirculation actuator defective:
   Fuel delivery is limited and exhaust-gas recirculation switched off.
5. Accelerator-pedal sensor defective:
   Idle speed is increased.

Malfunction/limp-home measure

6. Engine-speed sensor defective:
   Determination of a substitute engine speed from the start-of-injection signal.
   Cruise control and exhaust-gas-recirculation control are switched off. Start of injection is open-loop controlled, injection quantity reduced, max. engine speed limited, and idle speed increased.
7. Needle-motion sensor defective:
   Fuel delivery is limited and start of injection is open-loop controlled.
8. Road-speed sensor defective:
   Cruise control is switched off.
9. Water-temperature sensor defective:
   Control unit works with substitute values and exhaust-gas recirculation is switched off.
10. Air-temperature sensor defective:
    Control unit works with substitute values and exhaust-gas recirculation is switched off.
11. Fuel-temperature sensor defective:
    Control unit works with substitute values.
12. Actuating potentiometer defective:
    Engine stops, delivery-quantity actuator is switched off.
13. Pressure modulator for cruise control defective:
    Cruise control is switched off.
14. Charge-air/atmospheric-pressure sensor defective:
    No altitude correction on part of exhaust-gas recirculation.
15. Computer linkage (control unit) defective:
    Full-load delivery is reduced. Control unit works with substitute values.
16. Computer monitoring (control unit) defective:
    Control unit 1 defective: delivery-quantity actuation is switched off.
    Control unit 2 defective:
    Start-of-delivery solenoid-operated valve without current, exhaust-gas recirculation is switched off.

Service - Self-diagnosis

A self-diagnosis system is integrated in the control unit for the early detection of malfunctions. Damaged components or current paths are identified by specific blink codes. For this purpose an indicator lamp can be mounted in the dash board, which then lights up in case of a malfunction. The diagnostic program can be activated by pressing a button.

The program then starts with a start code and ends with an end code. The blinking displayed between the start and end codes indicates the defective operation.

If more than one malfunctions are present at the same time they can be called one after the other. Recognized malfunctions are stored in memory and are not deleted even after the ignition is switched off.

Example of a blink-code setup:

1.1 Program-end code
1.2 Program-start code
1.3 Air-temperature sensor defective
1.4 Coolant-temperature sensor defective
1.5 Fuel-temperature sensor defective
2.1 Accelerator-pedal sensor defective
2.2 Actuator potentiometer defective
2.3 Fuel-delivery actuation defective
2.4 Road-speed sensor defective
2.5 Cruise-control pressure regulator defective
3.1 Charge-air/atmospheric-pressure sensor defective
3.3 Air-flow sensor defective
3.4 Exhaust-gas-recirculation actuator defective
4.1 Engine-speed sensor defective
4.2 Needle-motion sensor defective
4.3 Start-of-injection solenoid-operated valve defective

Example of application:

1.2 Program-start code = 1 blink pulse - pause (approx. 3 - 4 s) - 2 blink pulses.

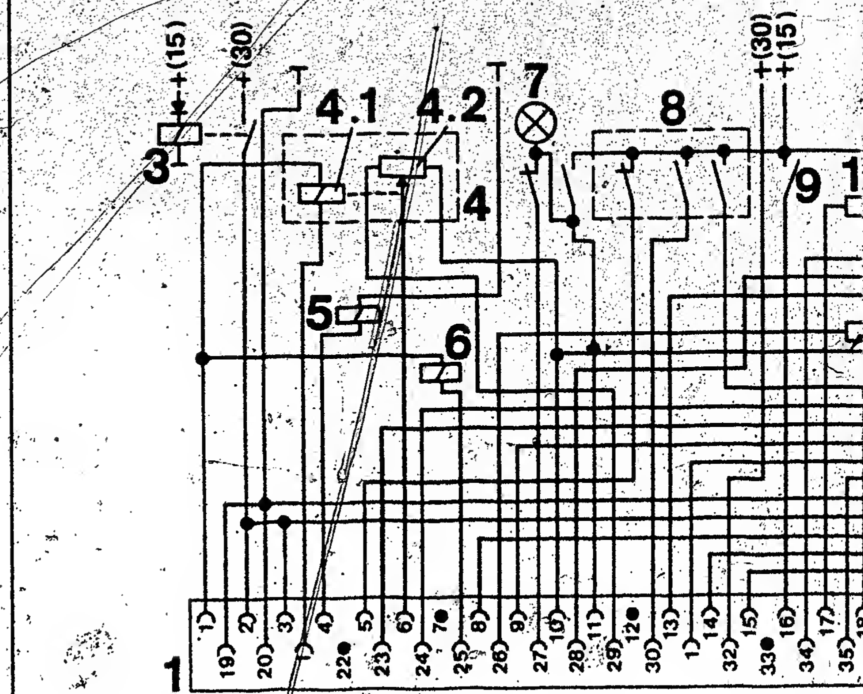
Deleting blink code

Depending on the design of the diagnostic program, a fault stored in memory can be deleted by simultaneously pressing the brake or clutch pedal and diagnosis-initiator button.

Published by:

Robert Bosch GmbH
Division KH
After-Sales Service Departments
for Training and Technology (KH/VSK)

Please direct questions and comments concerning the contents to the authorized RG/AV in your country

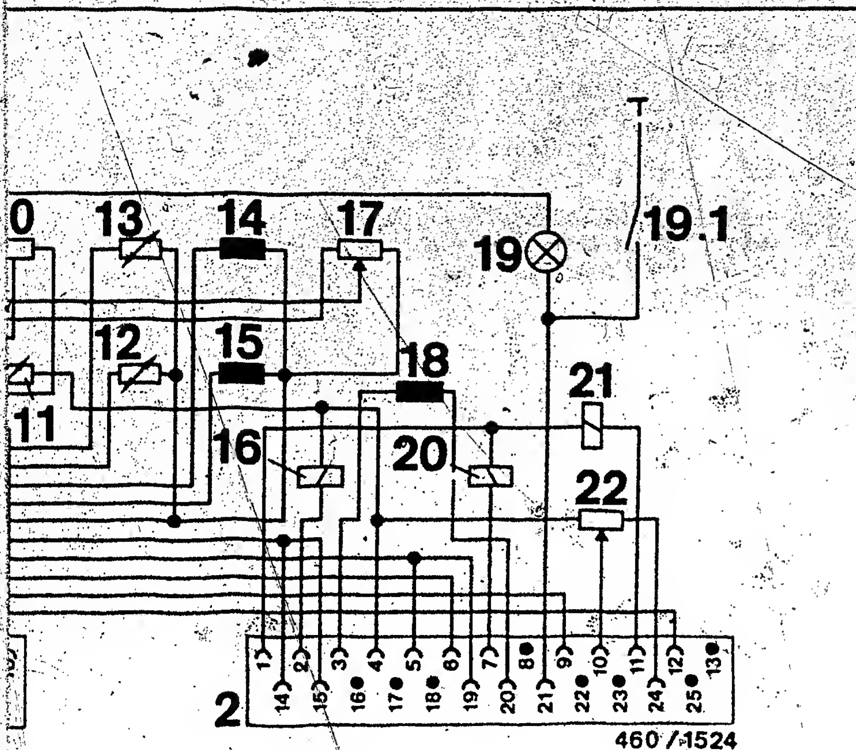


1 = Fuel-delivery control unit
2 = Exhaust-gas-recirculation/start-of-injection control unit
3 = Reversed-polarity protection relay
4 = Fuel-injection pump
4.1 = Fuel-delivery actuator
4.2 = Actuation potentiometer
5 = ELAB
6 = Pressure modulator *

7 = Stop lamps
8 = Cruise-contro
9 = Air condition
10 = Accelerator-p
11 = Air-temperatu
12 = Water-tempera
13 = Fuel-temperat
14 = Road-speed se
15 = Engine-speed
16 = Timing device

ELECTRICAL TERMINAL DIAGRAM OF AN ELECTRONICALLY-CONTROLLED DIES

F22



] operating lever
er
edal sensor
re sensor
ture sensor
ure sensor
nsor
sensor

17 = Charge-air/atmospheric-pressure sensor
18 = Needle-motion sensor
19 = Diagnostic display
19.1 = Diagnosis request
20 = EGR valve
21 = Gear-shift valve *
22 = Air-flow sensor

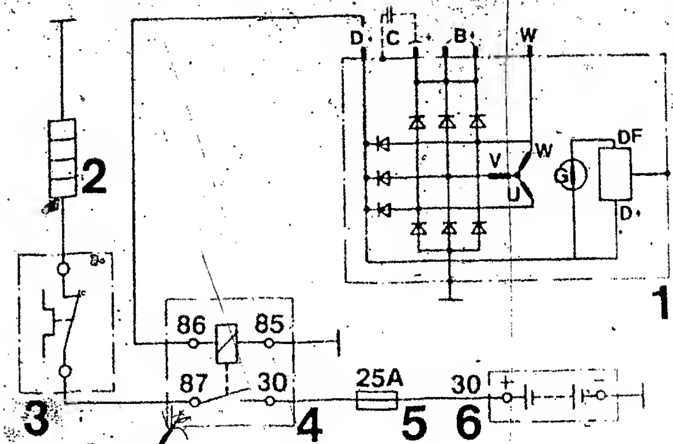
* = only on vehicles equipped with automic transmission

EL-FUEL-SYSTEM

Fuel-injection equipment
VDT-I-KFZ 101 En
01.86
Supersedes Ed. 11.85
KFZ 002

ELECTRIC DIESEL PREHEATER

Trouble-shooting for retrofit kit



1 = Alternator
2 = Heating element
3 = Thermo-time switch
4 = Switching relay
5 = Fuse 25 A
6 = Battery

These instructions describe the checking of the retrofittable electric diesel preheater 1 457 081 003, which is installed between fuel-filter cover and filter.

Motor Vehicle Service Information

BOSCH Geschäftsbereich KH, Kundendienst Kraftfahrzeug-Ausrüstung.
© by Robert Bosch GmbH, Postfach 50, D-7000 Stuttgart 1. Printed in the Federal Republic of Germany
Imprimé en République Fédérale d'Allemagne par Robert Bosch GmbH.

F24

Checking of diesel heater

Fault symptom: Engine starts poorly and/or stops while driving.

Open circuit in power supply to heating element

Functional check of 25 A fuse. Fuse O.K.?

no → Replace fuse.

yes ↓

Check voltage at term. 30 of switching relay. Voltage present?

no → Check for open circuit in lead from fuse holder to switching relay. Eliminate open circuit.

yes ↓

Check ground connection at term. 85 of switching relay. Ground present?

no → Check for open circuit in ground contact/lead. Eliminate oxidation/open circuit.

yes ↓

Check alternator voltage D+/61 at term. 85 of switching relay. Voltage present?

no → Check for open circuit in lead to alternator. Eliminate open circuit. (With engine stopped, use ohmmeter.)

yes ↓

Open circuit in power supply to heating element (continued)

Check voltage at thermo-switch (input). Voltage present?

- no: 1. Check for open circuit in lead to switching relay term. 87. Eliminate open circuit. 2. Switching relay defective - replace.
- yes:

Check Voltage at thermo-switch (output). Voltage present?

- no: 1. Temperature +15°C 2. Thermo-switch defective - replace.
- yes:

Check voltage at heating element (input). Voltage present?

- no: Check for open circuit in lead to thermo-switch. Eliminate open circuit.
- yes:

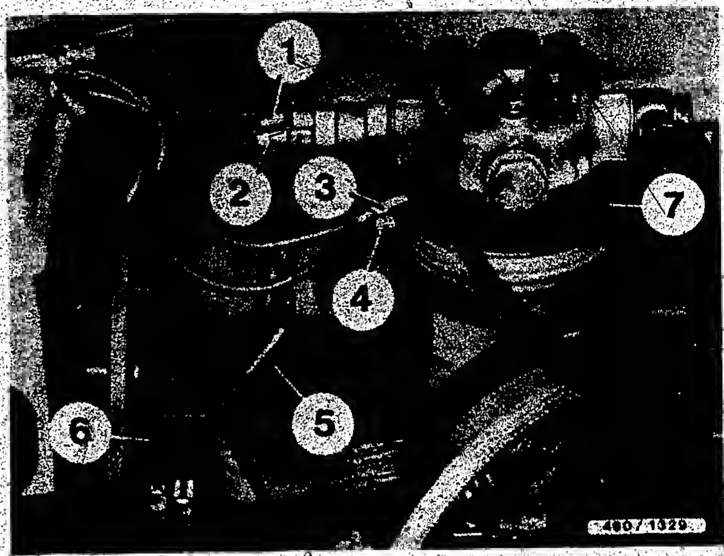
Check ground connection at heating element. Ground present?

- no: Check ground contact/lead for open circuit. Eliminate oxidation/open circuit.
- yes:

Check heating element. Connect ammeter and current consumption Specification: 3.5...8.5 A Specification obtained?

- no: Heating element defective - replace.
- yes:

Testing completed.



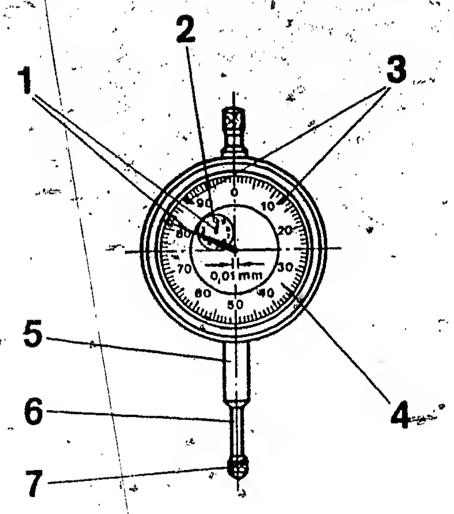
1 = Thermo-switch (input)
2 = Thermo-switch (output)
3 = Heating element (input)
4 = Heating element (output)
5 = Fuse holder
6 = Switching relay
7 = Heating element

Please direct questions and comments concerning the contents to our authorized representative in your country.

TESTING OF DIAL INDICATORS

VDT-I-KFZ 1000 En

1.1986



1 = Pointer	4 = Graduated scale
2 = mm indicator	5 = Clamping stem
3 = Adjustable tolerance marks	6 = Measuring pin
	7 = Measuring insert

To increase the adjustment accuracy when working with dial indicators (e.g. timing of fuel-injection pump to engine or setting of injection pumps on injection-pump test bench), it is necessary to subject dial indicators that are in use to an annual check.

	Motor Vehicle Service Information	

BOSCH

Geschäftsbereich KH. Kundendienst Kraftfahrzeug-Ausrüstung.

This check consists of a visual examination and a functional test.

Preparations for the testing of dial indicators

* Clean the dial indicator (no oil/grease on measuring pin).

* Visual examination for damage, sharp edges and burrs, corrosion.

* Repair of minor damage with oil stone, lapping paper, rust remover and prepared chalk.

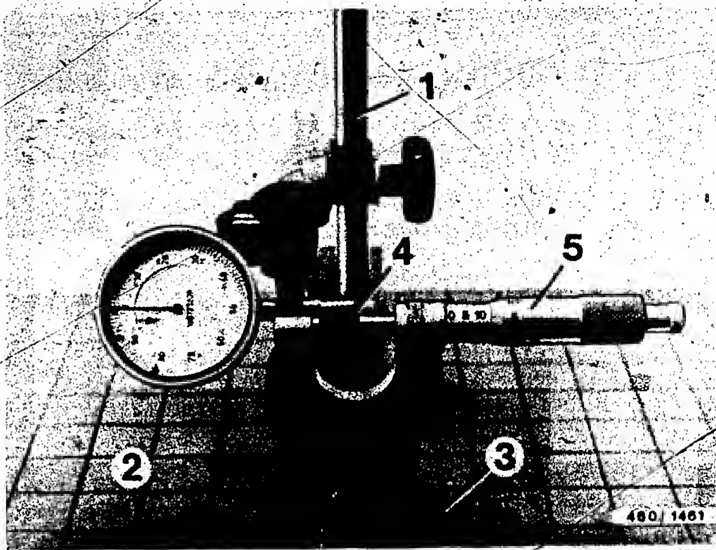
* Keep dial indicator and test equipment at room temperature for at least 30 minutes to equalize temperature.

Check the dial indicator for:

* Readability of graduated scale and numerals.
* Pointer advance in rest position at least 1/10 revolution before zero.
* Pointer overrun at least 1/10 revolution beyond indication range.
* Pointers and graduations must be straight, well-defined and of equal width.
* Rotatability of graduated scale.
* Check measuring insert for damage (scratches) and wear. Replace if necessary.
* Freedom of movement of measuring pin in clamping stem. The pointers must not graze and must follow the movement of the measuring pin without delay.
* Tolerance marks present and not damaged. Replace if necessary.

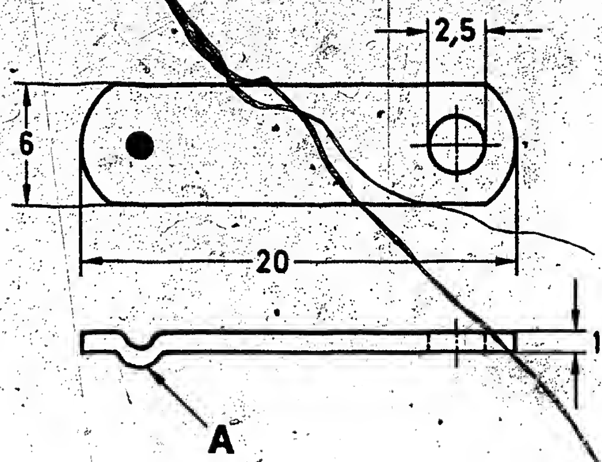
Note:

In case of complaints which cannot be repaired out, replace dial indicator.



1 = Dial-indicator holder (magnetic)
2 = Marking-out plate
3 = Measuring-instrument holder (e.g. Hahn & Kolb Stuttgart no. 31 415 010)
4 = Measuring stop (user-fabricated)
5 = Micrometer screw

Test setup

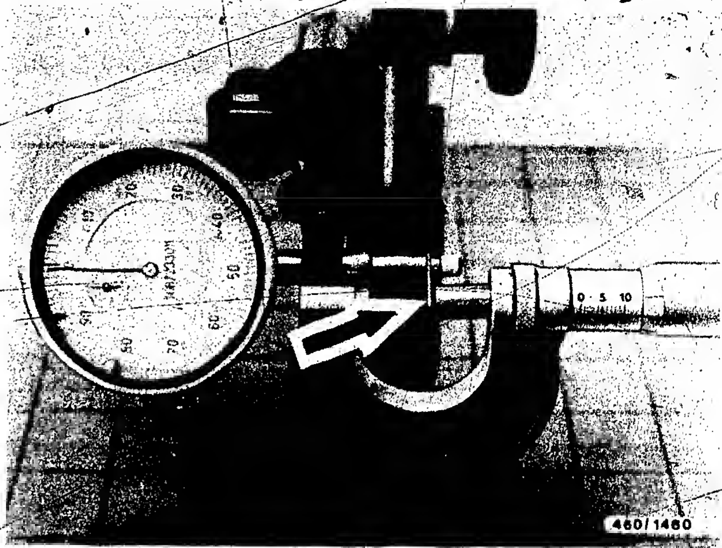


A = Measuring tip

Measuring stop (user-fabricated)

Note on fabrication:
Make measuring tip by means of rivet or blow with center punch.

Dimensions given in mm.



Functional test

Clamp dial indicator in magnetic holder (vertically in the case of dial indicators without spring reset).

Secure measuring-instrument carrier on marking-out board with adhesive tape at either side and clamp micrometer screw parallel to dial indicator.

Insert measuring stop between measuring insert and pin (arrow).

Unscrew measuring spindle of micrometer screw, depending on measuring range of dial indicator.

Preload dial indicator to "0" and, by screwing in the measuring spindle, go through the measuring range of the dial indicator.

When testing, set pointer and graduated mark on dial indicator to overlap millimeter by millimeter and read off the deviation on the vernier of the micrometer screw.

Maximum reading errors for dial indicators that are in use should be taken from the following table.

Measuring range

0...1mm	0...3mm	0...10mm	0...30mm
0.02mm	0.025mm	0.03mm	0.04mm

Static error of measured value

Check static error at two points within the measuring range.
Move to measuring point with measuring pin going in and with it going out, and measure the difference.

Allowable deviation for:
Measuring range 0...10mm : 0.01mm
0...30mm : 0.015mm

Note:
Allowable deviations do not correspond to DIN standard.
If the reading error is exceeded, repair or replace dial indicator.

Please direct questions and comments concerning the contents to our authorized representative in your country.

This information is available only in German. If necessary, please contact your regional representative.

Cette information n'est disponible qu'en allemand. Le cas échéant, veuillez vous adresser à votre représentation régionale.

Esta información está disponible únicamente en alemán. En caso necesario, sírvase dirigirse a su Representación Regional.

Questa informazione è disponibile solo in lingua tedesca. Se necessario, rivolgersi al proprio rappresentante di zona.

G8

This information is available only in German. If necessary, please contact your regional representative.

Cette information n'est disponible qu'en allemand. Le cas échéant, veuillez vous adresser à votre représentation régionale.

Esta información está disponible únicamente en alemán. En caso necesario, sírvase dirigirse a su Representación Regional.

Questa informazione è disponibile solo in lingua tedesca. Se necessario, rivolgersi al proprio rappresentante di zona.

This information is available only in German. If necessary, please contact your regional representative.

Cette information n'est disponible qu'en allemand. Le cas échéant, veuillez vous adresser à votre représentation régionale.

Esta información está disponible únicamente en alemán. En caso necesario, sírvase dirigirse a su Representación Regional.

Questa informazione è disponibile solo in lingua tedesca. Se necessario, rivolgersi al proprio rappresentante di zona.

G10

This information is available only in German. If necessary, please contact your regional representative.

Cette information n'est disponible qu'en allemand. Le cas échéant, veuillez vous adresser à votre représentation régionale.

Esta información está disponible únicamente en alemán. En caso necesario, sírvase dirigirse a su Representación Regional.

Questa informazione è disponibile solo in lingua tedesca. Se necessario, rivolgersi al proprio rappresentante di zona.

G11

This information is available only in German. If necessary, please contact your regional representative.

Cette information n'est disponible qu'en allemand. Le cas échéant, veuillez vous adresser à votre représentation régionale.

Esta información está disponible únicamente en alemán. En caso necesario, sírvase dirigirse a su Representación Regional.

Questa informazione è disponibile solo in lingua tedesca. Se necessario, rivolgersi al proprio rappresentante di zona.

G12

This information is available only in German. If necessary, please contact your regional representative.

Cette information n'est disponible qu'en allemand. Le cas échéant, veuillez vous adresser à votre représentation régionale.

Esta información está disponible únicamente en alemán. En caso necesario, sírvase dirigirse a su Representación Regional.

Questa informazione è disponibile solo in lingua tedesca. Se necessario, rivolgersi al proprio rappresentante di zona.

G13

This information is available only in German. If necessary, please contact your regional representative.

Cette information n'est disponible qu'en allemand. Le cas échéant, veuillez vous adresser à votre représentation régionale.

Esta información está disponible únicamente en alemán. En caso necesario, sírvase dirigirse a su Representación Regional.

Questa informazione è disponibile solo in lingua tedesca. Se necessario, rivolgersi al proprio rappresentante di zona.

G14

This information is available only in German.
If necessary, please contact your regional representative.

Cette information n'est disponible qu'en allemand. Le cas échéant, veuillez vous adresser à votre représentation régionale.

Esta información está disponible únicamente en alemán. En caso necesario, sírvase dirigirse a su Representación Regional.

Questa informazione è disponibile solo in lingua tedesca. Se necessario, rivolgersi al proprio rappresentante di zona.

G15

This information is available only in German.
If necessary, please contact your regional representative.

Cette information n'est disponible qu'en allemand. Le cas échéant, veuillez vous adresser à votre représentation régionale.

Esta información está disponible únicamente en alemán. En caso necesario, sírvase dirigirse a su Representación Regional.

Questa informazione è disponibile solo in lingua tedesca. Se necessario, rivolgersi al proprio rappresentante di zona.

This information is available only in German. If necessary, please contact your regional representative.

Cette information n'est disponible qu'en allemand. Le cas échéant, veuillez vous adresser à votre représentation régionale.

Esta información está disponible únicamente en alemán. En caso necesario, sírvase dirigirse a su Representación Regional.

Questa informazione è disponibile solo in lingua tedesca. Se necessario, rivolgersi al proprio rappresentante di zona.

G17

This information is available only in German. If necessary, please contact your regional representative.

Cette information n'est disponible qu'en allemand. Le cas échéant, veuillez vous adresser à votre représentation régionale.

Esta información está disponible únicamente en alemán. En caso necesario, sírvase dirigirse a su Representación Regional.

Questa informazione è disponibile solo in lingua tedesca. Se necessario, rivolgersi al proprio rappresentante di zona.

G18

This information is available only in German. If necessary, please contact your regional representative.

Cette information n'est disponible qu'en allemand. Le cas échéant, veuillez vous adresser à votre représentation régionale.

Esta información está disponible únicamente en alemán. En caso necesario, sírvase dirigirse a su Representación Regional.

Questa informazione è disponibile solo in lingua tedesca. Se necessario, rivolgersi al proprio rappresentante di zona.

G19

This information is available only in German. If necessary, please contact your regional representative.

Cette information n'est disponible qu'en allemand. Le cas échéant, veuillez vous adresser à votre représentation régionale.

Esta información está disponible únicamente en alemán. En caso necesario, sírvase dirigirse a su Representación Regional.

Questa informazione è disponibile solo in lingua tedesca. Se necessario, rivolgersi al proprio rappresentante di zona.

G20

This information is available only in German. If necessary, please contact your regional representative.

Cette information n'est disponible qu'en allemand. Le cas échéant, veuillez vous adresser à votre représentation régionale.

Esta información está disponible únicamente en alemán. En caso necesario, sírvase dirigirse a su Representación Regional.

Questa informazione è disponibile solo in lingua tedesca. Se necessario, rivolgersi al proprio rappresentante di zona.

G21

This information is available only in German. If necessary, please contact your regional representative.

Cette information n'est disponible qu'en allemand. Le cas échéant, veuillez vous adresser à votre représentation régionale.

Esta información está disponible únicamente en alemán. En caso necesario, sírvase dirigirse a su Representación Regional.

Questa informazione è disponibile solo in lingua tedesca. Se necessario, rivolgersi al proprio rappresentante di zona.

THERMAL-PROTECTION DISCS - REPLACEMENT

on nozzle holders - fitting in passenger cars

THERMAL-PROTECTION SLEEVES - REPLACEMENT

on nozzle holders - fitting in trucks

Thermal-protection discs are being fitted with success in order to reduce the coking-up of throttling-pintle nozzles. In addition, the fitting of such discs results in a noticeable reduction in the temperature of the nozzle base. This means that the service life of the nozzle is increased.
In the case of direct-injection engines, and in particular with pressure-charged models, the temperature at the nozzle-body tip rises due to the high combustion-chamber temperatures. This leads to a softening of the nozzle seat and a shortening of nozzle service life. The fitting of thermal-protection sleeves results in the temperature at the nozzle-body tip being reduced, which leads to a reduction in the degree of "softening" and hence an increase in service life of the nozzle.

Practically every engine manufacturer fits thermal-protection discs or sleeves in order to protect the nozzles from the effects of excessive heat.

These discs and sleeves are to be replaced as a matter of course every time the nozzle is removed and refitted. Damaged or distorted discs or sleeves can lead to the nozzle being overheated and, in some cases, to it jamming.

The thermal-protection discs are only to be fitted in a particular position, this must be adhered to under all circumstances. The fitting position of the discs is described in our After-Sales Service Instructions "Vehicle-related - VDT-W-460/...".
Discs and sleeves which are <u>not BOSCH products</u> must be obtained from the vehicle manufacturer.
If original equipment from BOSCH (e.g. VW), the disc 1 410 501 072 is used for DN...S nozzles and KCA nozzle holders. For DLLA...S nozzles (i.e. IH-Neuss), the sleeve 2 430 422 005 is used.

Please take steps to ensure that these discs and sleeves are in stock for the vehicles with which you are mostly concerned.

BOSCH Geschäftsbereich KH Kundendienst Kfz-Ausrüstung
by Robert Bosch GmbH D-7 Stuttgart 1 Postfach 50 Printed in the Federal Republic of Germany
Imprimé en République Fédérale d'Allemagne par Robert Bosch GmbH.

MIXING DIESEL FUEL WITH GASOLINE

VDT-I-Gen. 045 En

11.1981

Procedure

At temperatures below 0° C diesel fuel can precipitate paraffin, depending on its composition. These paraffin crystals block up the fuel filter. This leads to starting problems and even to vehicle failure.

To prevent the precipitation of paraffin, regular gasoline is mixed with diesel fuel in practice.

Danger of explosion

By adding carburetor fuel to diesel fuel ignitable mixtures can occur in the fuel tank under certain conditions.

Instructions

When adding gasoline to diesel fuel the maximum values given by the vehicle manufacturer must always be observed and adhered to.

Effects on our products

As regards wear and for viscosity reasons our products can withstand a mixture of max. 30% gasoline to diesel fuel.
Since the maximum values of the vehicle manufacturers lie below this figure, a negative effect on the quality or the service life of our products is not reckoned with.

BOSCH
Geschäftsbereich KH, Kundendienst Kfz-Ausrüstung
© by Robert Bosch GmbH, D-7 Stuttgart 1, Postfach 50. Printed in the Federal Republic of Germany.
Imprimé en République Fédérale d'Allemagne par Robert Bosch GmbH.

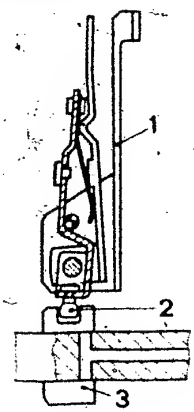
UNEVEN IDLE (ENGINE MISFIRE) VDT-I-Gen. 046 En
2.1982

Distributor-type fuel-injection pump VE..F..

Complaints are occasionally being received concerning a variety of different vehicles (e.g. Fiat Ritmo). The complaints are about uneven idle or engine misfire.
The cause of the changes in engine speed during normal operation (i.e. engine misfire) can be a loose ball pin in the fulcrum lever.
In order to repair, the fulcrum lever must be removed and the ball pin (2) checked to ensure that it is seating firmly.

<u>Instructions for checking the ball pin:</u>

Remove the fulcrum lever (1) and check the ball pin (2) for firm seating. If the ball pin is loose, fit a new fulcrum lever and ball pin.



1 = Fulcrum lever (Pos'n. 95)
2 = Ball pin
3 = Control collar

DISTRIBUTOR FUEL-INJECTION PUMP VE.. F.. VDT-I-Gen. 062 En

2.1984

Complaints regarding idle shake
and/or black smoke

Supersedes Ed. 12.1983

With individual vehicles fitted with VE-distributor pumps, complaints may arise concerning "idle shake" and/or "black smoke".

1. Idle shake and black smoke

If such complaints are received, first of all the delivery valves are to be checked, and damaged or broken valves replaced.

The following pointers are given as an aid to trouble-shooting:

If the delivery valve is broken it delivers too much fuel from the outlet in question. The magnitude of this excessive quantity can only be determined on the test bench.

If the injection lines are disconnected one after another from the nozzle holders, the outlet with the broken delivery valve can be localised. This is because the disconnection of the outlet which is delivering too much fuel results in a far more pronounced speed drop than is the case with the intact delivery valves.

The delivery valves can be replaced in the vehicle if it is possible to tighten them with the specified torque of 40 Nm ± 2 Nm (see also VDT-I-460/132, 2.1984).

If the idle shake has been cured by these measures, but not the black smoke at full load, then the measures detailed in the following paragraph are to be carried out.

2. Black smoke

If complaints are received about black smoke, this can be caused by the delivery quantity having increased by 2...3 cm^3/1000 strokes.

It is not necessary to remove the pump in order to cure this fault. It suffices if the full-load adjusting screw is screwed out by about 0.2 mm (approx. 1/4 turn). The screw is then to be sealed again with locking paint/varnish.

The work detailed above is to be carried out free of charge within the warranty period, and warranty-processing will be in the normal manner.

Please direct questions and comments concerning the contents to our authorized representative in your country.

BOSCH Geschäftsbereich KH Kundendienst, Kfz-Ausrüstung

This information is available only in German.
If necessary, please contact your regional representative.

Cette information n'est disponible qu'en allemand. Le cas échéant, veuillez vous adresser à votre représentation régionale.

Esta información está disponible únicamente en alemán. En caso necesario, sírvase dirigirse a su Representación Regional.

Questa informazione è disponibile solo in lingua tedesca. Se necessario, rivolgersi al proprio rappresentante di zona.

G27

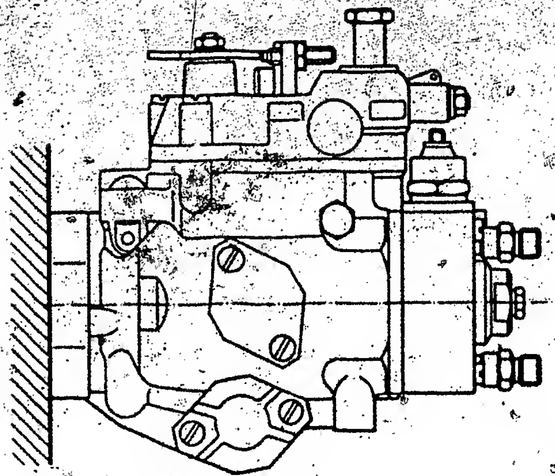
Fuel-injection equipment

VDT-I-Gen. 069 En

11.1984

supersedes I-460/120 of 1.81

BLEEDING OF DISTRIBUTOR-TYPE FUEL-INJECTION PUMPS VE..F..

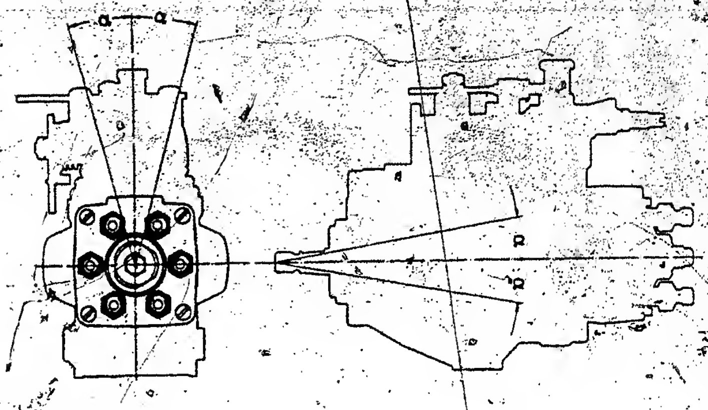


If distributor-type fuel-injection pumps are mounted on the engine, always fill injection pump and fuel filter with fuel.

Horizontally (see picture) mounted distributor-type fuel-injection pumps do not need to be bled since the fuel overflow forms the highest point on the distributor-type pump, and the air in the distributor-type pump is forced back to the tank.

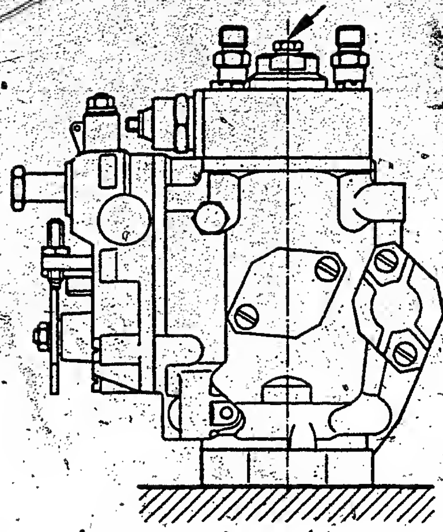
Motor Vehicle Service Information

BOSCH Geschäftsbereich KH, Kundendienst Kraftfahrzeug-Ausrüstung.



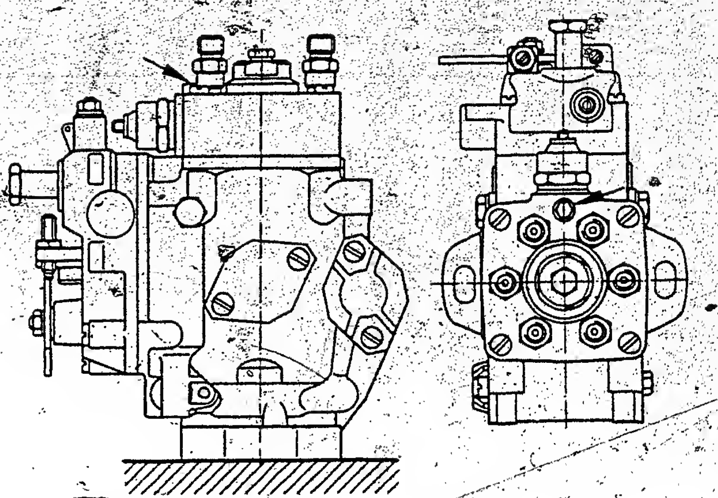
a = Angle of inclination

If the installation position differs by more than 45° (see picture) from the horizontal, then in most cases it will be necessary to bleed the distributor-type fuel-injection pump.



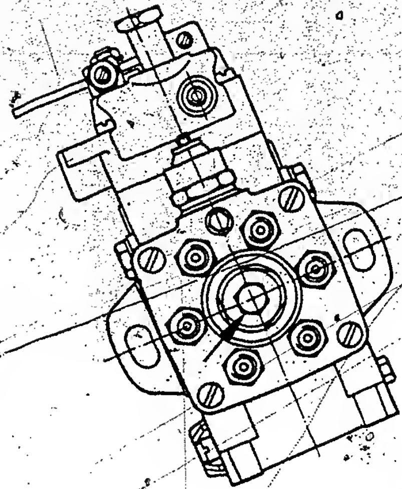
1. Vertical installation

To bleed vertically installed distributor-type fuel-injection pumps, open hexagon screw in central screw plug of hydraulic head (see picture, arrow) until flat place on thread becomes visible. Operate starting motor until fuel escaping at this point is free of bubbles; then re-tighten hexagon screw.



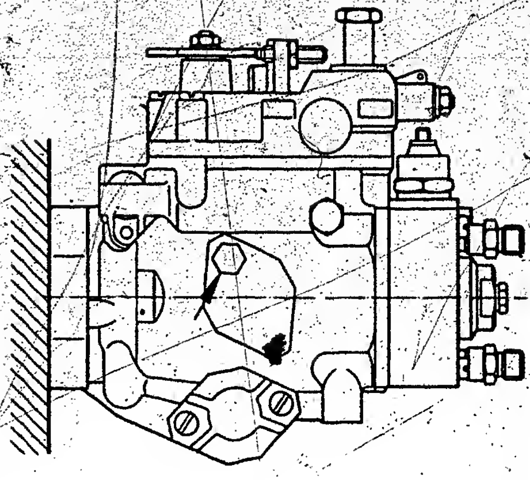
In various versions of distributor-type fuel-injection pump (VE), a hexagon-socket-head cap screw is positioned below the solenoid-operated valve (see picture, arrow).

To bleed these versions of pump, loosen this hexagon-socket-head cap screw. Operate starting motor until fuel escaping at this point is free of bubbles; then re-tighten hexagon-socket-head cap screw.



2. Horizontal installation

To bleed horizontally installed distributor-type pumps (see picture), it is necessary, as in the case of vertical installation, to loosen the hexagon screw (arrow) in the central screw plug of the hydraulic head, and to re-tighten it after the fuel escaping is free of bubbles.



In various versions of pump, the bleeder screw is positioned on the side of the pump housing, see picture. (Distributor-type pump is shown horizontal for better clarity).

To bleed these distributor-type pumps, loosen the hexagon screw (arrow) shown in the picture. Operate starting motor until fuel escaping at this point is free of bubbles; then re-tighten bleeder screw.

Published by:
Robert Bosch GmbH
Division KH
After-Sales Service Department for
Training and Technology (KH/VSK)

Please direct questions and comments concerning the contents to our authorized representative in your country.

[redacted]

40...46, 58
I-Gen. 070 En
11.1984

DIESEL KIKI FUEL-INJECTION PUMPS
AFTER-SALES SERVICE PROCEDURE

General

Diesel Kiki Co. Ltd. (DKKC) with headquarters in Tokyo is one of the leading original-equipment manufacturers of the Japanese automobile industry in the diesel injection sector and produces, among other things, distributor-type and in-line fuel-injection pumps (types VE and A) under Bosch licence.

To guarantee the after-sales service and the supply of service parts, Robert Bosch GmbH and Diesel Kiki Co. Ltd. have agreed to perform the after-sales service on DKKC injection systems in Europe through the Bosch After-Sales Service Organization.

Scope of service

The after-sales service covers the entire fuel-injection system (pump, governor, nozzle-and-holder assembly, filter) of all passenger cars, estate cars (station wagons), vans and engines which have been exported to Europe.

The after-sales service for DKKC-equipped commercial vehicles and construction machinery which are exported to Europe only in small numbers will continue to be performed by the vehicle/construction machinery manufacturers.

Technical Bulletin

BOSCH
Geschäftsbereich KH. Kundendienst Kraftfahrzeug-Ausrüstung.

Special service tools

The sale of special service tools will be performed by RG/AV. Inclusion of the DKKC service tools in the tool program is in preparation.

Replacement products/service parts

The DKKC products and service parts will be sold through the usual channels like all KH products and service parts. The products and service parts will be stocked at KH in Karlsruhe and at the European RG/AVs and have all been recoded to BOSCH Part Numbers.

Training

Integration of DKKC assemblies in RG/AV training courses.

Warranty procedure

Procedure as for RB products through RG/AV.

DKKC-equipped vehicles

See also microfiche AA-83 (08.84)

Isuzu	KBD (Pickup) Trooper UBS (off-road vehicle) WFR 51 (van)
Mazda	626 D E 2200 (van)
Mitsubishi	Colt 1800 GL Lancer 1800 GL Galant 1800, 2300 Pajero 2300 L 300

H7

Nissan-Datsun Bluebird
Laurel
Patrol (hardtop and station)
Urvan
Pickup, UP

Technical documentation

All necessary documentation will be integrated in the Bosch documentation system.

Equipment microfiche	AA..	Distributed 8/84
Service-parts lists	EP 397, 398, 399	Distributed 8/84
Cross-reference	HB 30	Distributed 8/84
Test specifications	WP Distribution when ready through DKKC	
Testing and repair instructions	W-40./...(SIS) W-46./...(SIS) Distribution when ready through DKKC	
Trouble-shooting instructions for vehicles with DKKC injection pumps	Distribution when ready through DKKC	

Note

The previous original DKKC microfiches will in future be reduced to just a few microfiches. Since the DKKC pumps are virtually identical with BOSCH pumps, the contents will be restricted to assemblies which differ from Bosch injection pumps or which are purely DKKC-specific.

Published by:

Robert Bosch GmbH
Division KH
Technical After-Sales Service (KH/VKD2)

Please direct questions and comments concerning the contents to our authorized representative in your country.

Technical Bulletin

SEALING OF FUEL-INJECTION PUMPS BY ENGINE MANUFACTURERS

Destroy VDT-BMP 001/52 of 8.8.1973

The firms listed below obtain basic models of fuel-injection pumps from us and, with our approval, set the full load delivery and speed for various engine types themselves. It may also be the case that the full load delivery of pumps set during production is slightly altered according to engine requirements. In such cases, the seal of the engine manufacturer in question is to be found on our fuel-injection pumps. The markings are listed below.

If a justified guarantee claim is made within the period of warranty, the procedure is the same as for pumps sealed by us, i.e. the guarantee case is to be reported in the usual manner with ~~punch~~ cards, written documents or collective guarantee report. Faulty adjustment of fuel-injection pumps sealed by one of the firms listed below should be reported under fault no. 15.

Vehicle manufacturer	Marking (wire seal) Front	Front and rear	Rear	Marking (die seal)
AEC		AEC		—
Albin		ALBIN		—
Alfa Romeo	ALFA		ROMEO	—
Allis Chalmers			29	
			64	
Bolinder-Munktell				—
Büssing		BUSSING		Bü
Case				—

BOSCH Geschäftsbereich KH Kundendienst, Kfz-Ausrüstung.
© by Robert Bosch GmbH, D-7 Stuttgart 1, Postfach 50. Printed in the Federal Republic of Germany
Imprimé en République Fédérale d'Allemagne par Robert Bosch GmbH.

H9

Vehicle manufacturer	Marking (wire seal) Front	Marking (wire seal) Front and rear	Marking (wire seal) Rear	Marking (die seal)
Daimler-Benz				
Eicher	Eicher			—
Eicher	Eicher		V	—
		P		
Fiat	FIAT		S.P.A	—
GMC		GMC		
Hanomag				
Henschel		H		
John Deere	CD		JD	—
IHC		IH		—
KHD		KLÖCKNER HUMBOLDT DEUTZ AG		
Mack	MACK		HAGT	CH
MAN		MAN		MAN
MWM		MWM		
Murphy Diesel with MWM engine		M.D. CO		—
New Idea Farm Equipment		N.I.		
Opel				
Manufacturer's seal				
Customer service seal	KD			
Manufacturer's seal for Sweden (Emission standards seal)				
Peugeot-Indenor		IND		—

Vehicle manufacturer	Marking (wire seal) Front	Front and rear	Rear	Marking (die seal)
Saab - Scania	SCANIA S		LT 45	
Schlüter				—
Steyr-Daimler-Puch		STEYR		STEYR
Südbremse München		SB		—
Volvo		volvo		—
Volvo-BM Volvo-Penta				— —
Volvo and Volvo Penta			No. 343...358	
Waukesha and Waukesha-Scania		W		

Kundendienst KH
Technische Mitteilung

Only for use within the Bosch organization. Not to be communicated to any third party.

EP 40
VDT-BEP 102/1 B
<VDT-I-403/1 B>
Edition 8.1974
Translation of German edition of 10.7.1974

New Product
"MW" Diesel Fuel Injection Pump

A new Bosch diesel fuel injection pump, the "MW", is being fitted, together with the "RW" mechanical governor, in the new Daimler-Benz vehicle with a 5-cylinder engine (OM 617).

The fuel injection system consists of the following major components:

Fuel injection pump:	PES 5 MW 55/320 RS 3 PES 5 MW .. RS.. USA model (green nameplate) MW = pump size M, heavy-duty
Mechanical governor:	RW 350/2200 MW 2 RW = governor with tensioning lever MW = governor for pump size "MW"
Supply pump:	FP/K 22 MW 3 MW = supply pump for pump size "MW"

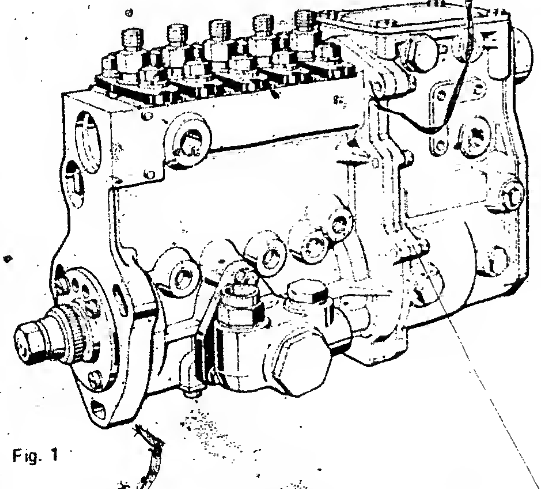


Fig. 1

Construction and Operation

1. Fuel injection pump

The delivery and metering of the fuel ensues according to the familiar working methods of Bosch fuel injection pumps.

The special characteristics and properties of this fuel injection pump are:

- Temperature-resistant, pre-assembled barrel and valve assembly as an independent subassembly.
- Closed die-cast stress-free housing, with base cover.
- The basic adjustment to the fuel delivery is made externally by turning the barrel and valve assembly, and that of the port closing by placing spacers under the holding flange of the barrel and valve assembly.
- Control rod with ball linkage, non-chip metal formed.
- Stiffer camshaft, torsion-proof and resistant to bending. Makes possible high injection pressure and short duration of injection.
- No adjustment of the axial play of the camshaft necessary.
- Maintenance-free through connection to engine lubrication system.
- Choice of mounting position of partly integrated automatic timing device.

I-403/11
Seite

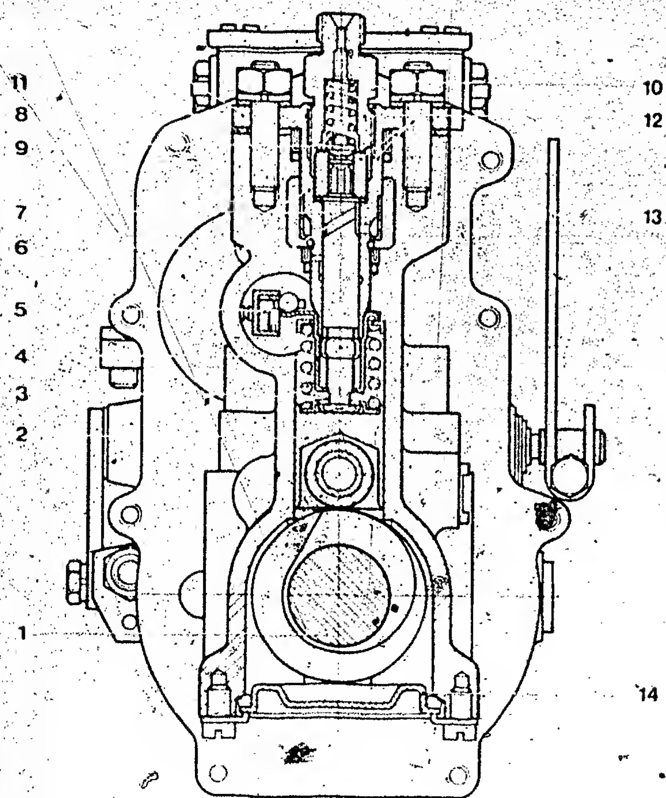


Fig. 2

Notes to Fig. 2

1 = Camshaft
2 = Roller tappet
3 = Helical compression spring
4 = Control sleeve
5 = Control rod
6 = Control edge
7 = Plunger and barrel assembly
8 = Adjusting plate
9 = Delivery valve assembly
10 = Delivery valve spring
11 = Holding flange
12 = Barrel and valve assembly
13 = Control lever
14 = Cover

2. Mechanical governor

The "RW" mechanical governor is a maximum minimum governor. It can also be produced as variable speed governor type "RWV" for other vehicles.

The special characteristics and properties of this governor are

- All adjustments can be easily undertaken after removal of the governor end cover.
- Pneumatic shut off device controlled by switch in steering column. (Vacuum pump control valve in steering column switch · pneumatic shut off device).
- Speed-dependent, mechanical regulation of starting fuel delivery
- Various possibilities on the upper side of the governor for fitting ancillary devices for characteristic curve correction. (Altitude compensation, manifold pressure compensation, temperature compensation).
- The governor is very powerful and this results in a high degree of regulating accuracy.
- Non-chip metal formed governor parts.
- Flyweight assembly damped against vibration.
- Control lever only needs to exert very low adjusting forces.

Notes to Fig. 3

1 = Speed droop adjustment
2 = Nominal speed adjustment
3 = Idle adjustment
4 = Full-load adjustment for RWV
5 = Driver
6 = Fulcrum lever
7 = Linkage lever
8 = Follower lever
9 = Control rod
10 = Linkage point
11 = Helical compression spring
12 = Sliding sleeve
13 = Swivel lever
14 = Drive plate
15 = Needle roller bearing
16 = Flyweight
17 = Rubber cushion
18 = Leaf spring
19 = Bell crank
20 = Governor spring
21 = Adjusting shaft
22 = Control lever
23 = Edge cam for RWV
24 = Idle auxiliary spring
25 = Tensioning lever
26 = Driver screw for RWV
27 = Spring retainer for RW
28 = Pneumatic shut-off device

I- 403/1
Seite 3

Construction of the "RW" Mechanical Governor

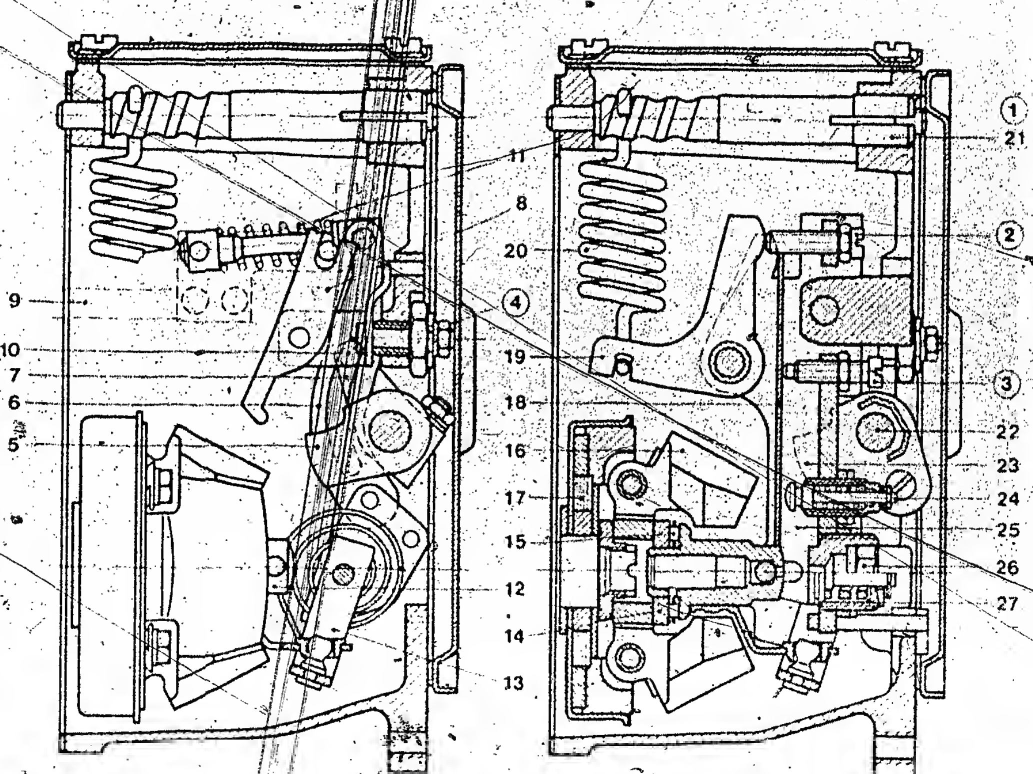


Fig. 3

The flyweight assembly is fastened on the camshaft of the fuel injection pump together with a vibration damper.
When the 4 flyweights 16 swing outwards they push the sliding sleeve axially via a drive plate 14 and needle roller bearing 15.

The tensioning lever 25 is swivel-mounted on a bolt in the housing. It carries an adjustable bell crank 19, to which is attached the governor spring 20, with which the nominal speed can be adjusted ② . The upper loop of the governor spring is looped over the adjusting shaft 21 and serves to adjust the speed droop ① . Apart from this, an adjustable leaf spring 18 and an idle auxiliary spring 24 are mounted on the tensioning lever 25 to adjust the idle speed ③ . Idle adjustment does not influence the nominal speed.

The movement of the sleeve is transferred to the fulcrum lever 6 and the control rod 9 of the fuel injection pump via the swivel lever 13 mounted in the housing. The linkage lever 7, which is fixed to the external control lever 22, fits in the slit in fulcrum lever 6. During acceleration the lever advantage of linkage lever 13 to control rod 9 alters via control lever 22 and linkage point 10 of the linkage lever 7. Between the idle and maximum speeds the position of the control rod and hence the quantity of fuel injected can be directly selected by the control lever 22. Full-load delivery is adjusted by means of the external stop of the control lever 22.

Regulation of the starting fuel delivery is speed dependent.

Starting fuel delivery is only possible below idle speed and takes place when the follower lever engages with the driver 5.

A spring retainer 27 in the tensioning lever 25 ensures fuel quantity compensation.

I-403/1
Seite 4

Diagramatic view of RW Mechanical Governor

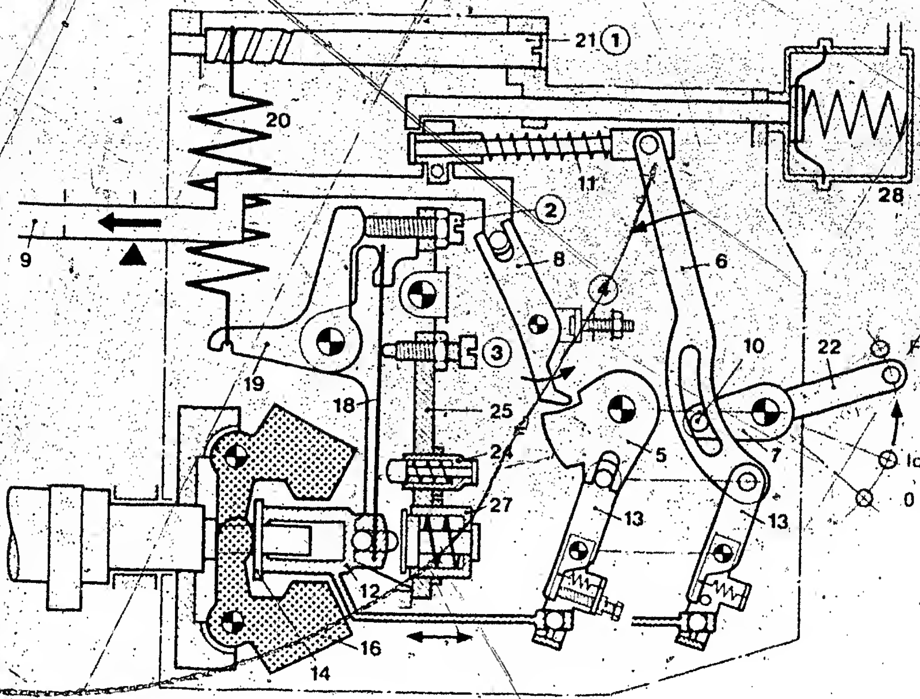


Fig. 4 Starting position

Notes to Fig. 4

① = Speed droop adjustment
② = Nominal speed adjustment
③ = Idle adjustment.
④ = Full-load adjustment for RWV
5 = Driver
6 = Fulcrum lever
7 = Linkage lever
8 = Follower lever
9 = Control rod
10 = Linkage point
11 = Helical compression spring
12 = Sliding sleeve
13 = Swivel lever
14 = Drive plate
16 = Flyweight
18 = Leaf spring
19 = Bell crank
20 = Governor spring
21 = Adjusting shaft
22 = Control lever
24 = Idle auxiliary spring
25 = Tensioning lever
27 = Spring retainer for RW ...
Driver-screw for RWV (not shown)
28 = Pneumatic shut-off devices

The difference between the RWV and RW governors is that on the RWV-type the linkage point 10 on the linkage lever 7 is controlled by a special torque cam.

When accelerating or pushing the control lever forwards, the control rod is at once pushed in the "more fuel" direction, until follower lever 8 contacts the edge cam 23 (full-load stop). When the control lever or linkage lever 7 is pushed further forward then the helical compression spring 11 is compressed. As speed increases, the compression on the spring decreases. When the desired speed is attained, then the control rod is pulled back and effects speed regulation.

Fuel quantity compensation is effected not by means of the spring retainer 27 but through the curve on the (speed-dependent) edge cam, which is sensed by the follower lever 8.

After-Sales Service Note:
After-sales service follows normal lines for this series of pumps and governors. Technical workshop documentation as well as testing and repair tools will be placed at your disposal.

ROBERT BOSCH GMBH
Geschaftsbereich KH
Kundendienstschule

H15

[redacted]

New product

40

PE(S) . . MW . .
Combined atmospheric and manifold-pressure compensator (ALDA)

VDT-I-403/2 En
7. 1978

Technical information sheet VDT-I-403/1 En describes how the diesel fuel-injection pump PE(S) . . MW . . with governor RW . . MW . . works.

As a new variation of this pump combination a model has been designed with combined atmospheric and manifold-pressure compensator.

1. Combined atmospheric and manifold-pressure compensator (ALDA)

With pressure-charged engines, the full-load delivery is determined by a changeable i.e. manifold-pressure dependent air-charge in the engine cylinders. In the lower rotational-speed range the air charge in the engine cylinders is less and the full-load delivery must be adjusted correspondingly to the reduced air charge.

The air charge in the individual engine cylinders is dependent, however, not only on the charge-air pressure but also on the respective atmospheric pressure.

Both pressures together (charge-air pressure and atmospheric pressure) give the combined (absolute) pressure.

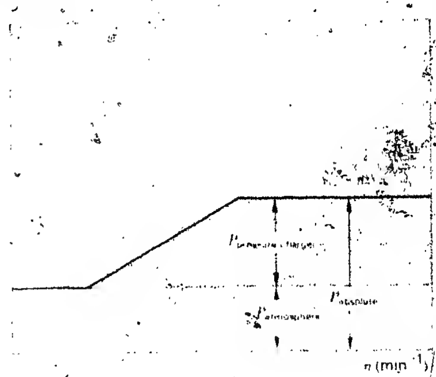


Fig. 1

As can be seen from the diagram (fig. 1), above the respective atmospheric pressure the air is compressed by the engine pressure-charger.

The result is that the prevailing pressure in the intake manifold becomes the absolute pressure . . .

BOSCH Geschäftsbereich KH Kundendienst Kfz-Ausrüstung
© by Robert Bosch GmbH, D-7 Stuttgart 1, Postfach 50 Printed in the Federal Republic of Germany
Imprimé en République Fédérale d'Allemagne par Robert Bosch GmbH

2. The function of the ALDA

The absolute pressure (atmospheric pressure + charge-air pressure) from the intake manifold of the engine affects the aneroid capsules of the ALDA aneroid box (147).

The correcting linkage (120) is positively connected to the aneroid capsules.

The linkage lever (39) of the governor linkage is connected to the template of the correcting linkage and to the fulcrum lever (6) of the governor linkage in such a way that it can move. All movements of the aneroid capsules are therefore transferred to the control rod via the correcting linkage, the template, the reverse-transfer lever and the fulcrum lever.

The more the control lever (8) is pushed towards idle, the nearer the bearing point of the linkage lever in the template moves towards the pivot (A) of the template.

The effect of the ALDA-control decreases the more the control lever is moved in the idle direction.

When the control lever is in idle the effect of the ALDA-control approaches nil.

When the absolute pressure falls the aneroid capsules change in length, i.e. they expand. The correcting linkage is pressed downwards. The template thereby moves around the pivot (A) in the direction a.

The linkage lever swings around the pivot (C) in the direction b.

This causes the fulcrum lever to move around the pivot (B) in the direction C.

The control rod is moved in the direction "less delivery".

When the absolute pressure increases (higher air and/or charge-air pressure) the movement takes place in the opposite direction.

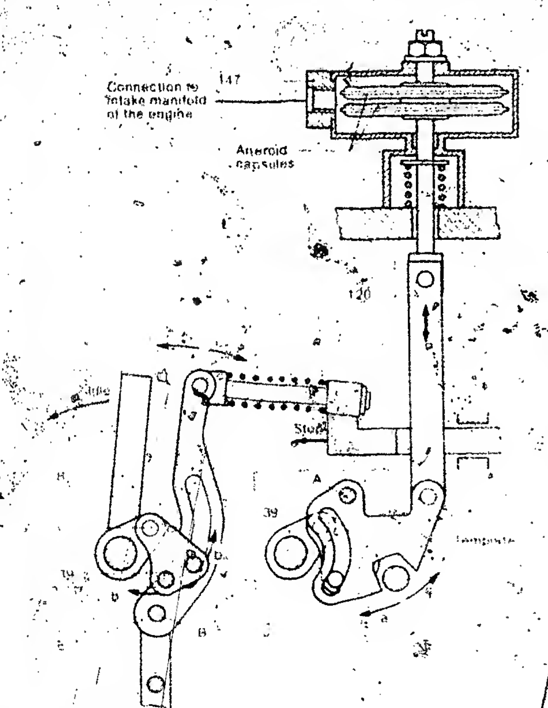
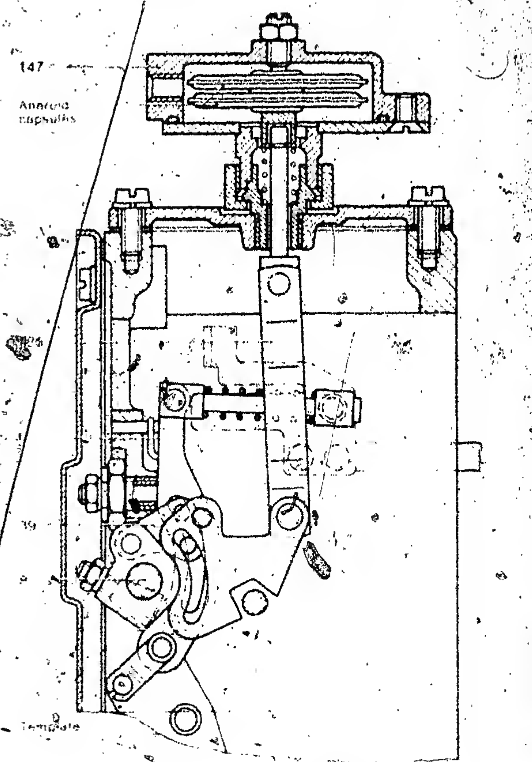


Fig. 2



A = Pivot template
B = Pivot fulcrum lever
C = Pivot linkage lever
6 = Fulcrum lever
8 = Control lever with setting shaft
39 = Linkage lever
120 = Correcting linkage
147 = Aneroid box

Fig. 3

40...46,58
VDT-I-434/100 En
1.1986

ENGINE KNOCKING AT PART LOAD

in Mercedes-Benz passenger cars, off-road vehicles and commercial vehicles

If, with the engine at normal operating temperature, the complaint "engine knocking" occurs on the above-quoted vehicles with engines OM 615, 616, 617, an improvement can be obtained by installing the flat-type pintle nozzle DN 0 SD 261 (0 434 250 120).

The nozzle DN 0 SD 261 is also installed in the 190 D (engine OM 601).

The nozzles should be replaced in sets.

The work is subject to payment.

Published by:

ROBERT BOSCH GMBH
Division KH
Technical After-Sales Service (KH/VKD 2)

Please direct questions and comments concerning the contents to our authorized representative in your country.

Technical Bulletin

New Product

VDT-I-460/1 B
Ed. 1
11. 1975
Translation of
German edition
of 9. 1975

0 460 4 ..
Distributor-type fuel injection pump VE .. F ..

The description is given of a novel Bosch distributor-type fuel injection pump.

In this pump (high pressure pump) supply pump, governor and timing device are combined.

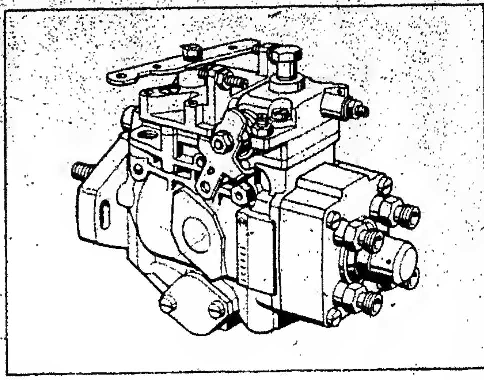


Fig. 1

Features and characteristics

This distributor-type fuel injection pump differs from the EP/VA fuel injection pump mainly in the control system.

The particular features and characteristics are

- Mechanical governor, which is driven through gears from the pump drive.
- Largely unaffected by temperature and viscosity.
- Hydraulic head and governor separated, thus fewer types of hydraulic head (facilitates servicing)
- Can be fitted with a wide range of accessories for control of the full-load delivery as a function of
  - charge-air pressure
  - atmospheric pressure
  - temperature.
- Hydraulic and mechanical correction of fuel delivery (positive and negative torque control).
- Choice of variable-speed governing or maximum-minimum-speed governing. Combination of both systems also possible.
- Permits easier adaptation to engine to achieve an optimum for performance, exhaust gas, consumption, torque, etc.
- Adjustment of start of injection dependent on load and rotational speed.
- Governor parts manufactured by non-cutting method.

BOSCH
GERMANY
Geschäftsbereich KH Kundendienst Kfz-Ausrüstung
© by Robert Bosch GmbH, D-7 Stuttgart 1, Postfach 50 Printed in the Federal Republic of Germany
Imprimé en République Fédérale d'Allemagne par Robert Bosch GmbH

H19

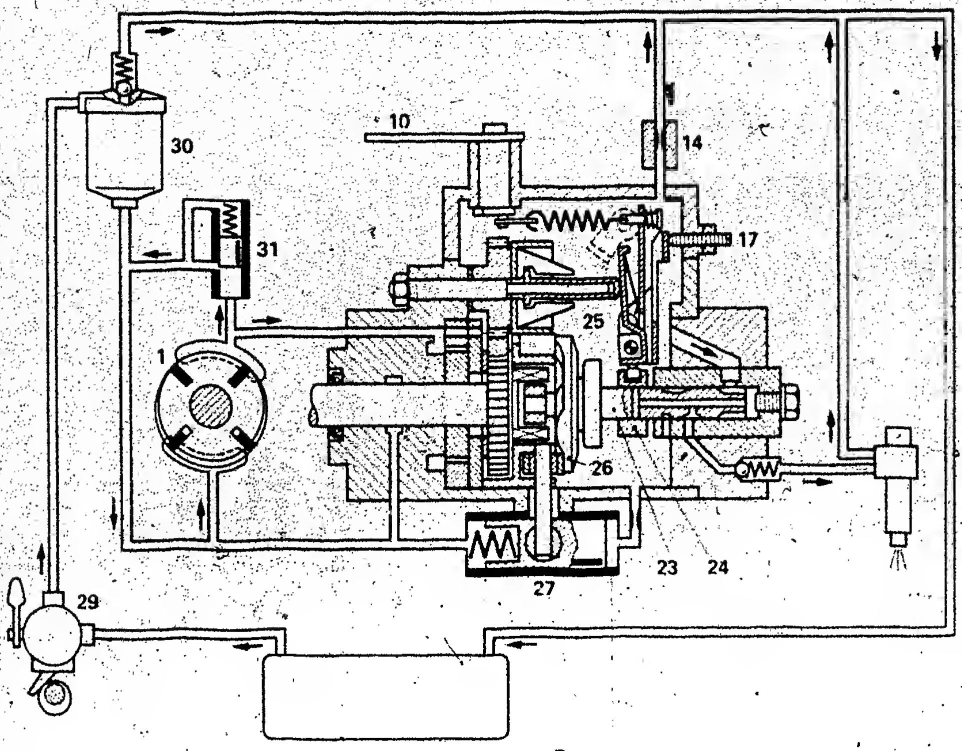


Fig. 2

Legend for Figs. 2 and 3

1 = Vane supply pump
2 = Drive shaft
3 = Gear wheel
4 = Pressure disc
5 = Governor spindle
6 = Sliding sleeve
7 = Governor cage
8 = Flyweights
9 = Governor spring
10 = Control lever
11 = Adjustment screw (idle)
12 = Adjustment screw (rated speed)
13 = Stop lever
14 = Excess-flow valve
15 = Correction lever
16 = Retaining pin
17 = Adjustment screw (full load)
18 = Idle spring
19 = Tensioning lever
20 = Starting spring
21 = Starting lever
22 = Outlets
23 = Distributor-pump plunger
24 = Regulating collar
25 = Pump interior
26 = Cam plate
27 = Timing-device piston
28 = Cam roller ring
29 = Pre-supply pump
30 = Fine filter
31 = Pressure-regulating valve

Construction and operation

1. Fuel circuit and circulation (Fig. 2)

The fuel is drawn from the tank by the pre-supply pump (29) and conveyed via a fine filter (30) to the vane supply pump (1) The vane supply pump supplies a constant quantity per revolution, and produces pressure via the pressure-regulating valve (31). The majority of the fuel conveyed flows through the pressure-regulating valve back again to the suction side The remainder flows through the pump interior (25) to be conveyed into the high-pressure chamber of the hydraulic head or flows through the excess-flow valve (14) back to the tank for cooling and removal of air.

The distributor-pump plunger (23) is actuated by the drive shaft (2). The cam plate (26) and rollers in the cam roller ring (28) cause a stroke movement to be imparted in addition to the rotary movement

The stroke produces feed at high pressure and the distribution of the injected quantity to the individual outlets (22) is made through a metering slit in the distributor-pump plunger.

The port opening is controlled by the regulating collar (24) opening the spill ports in the pump plunger The fuel flows back into the pump interior (25)

The mechanical governor controls the regulating plunger (24)

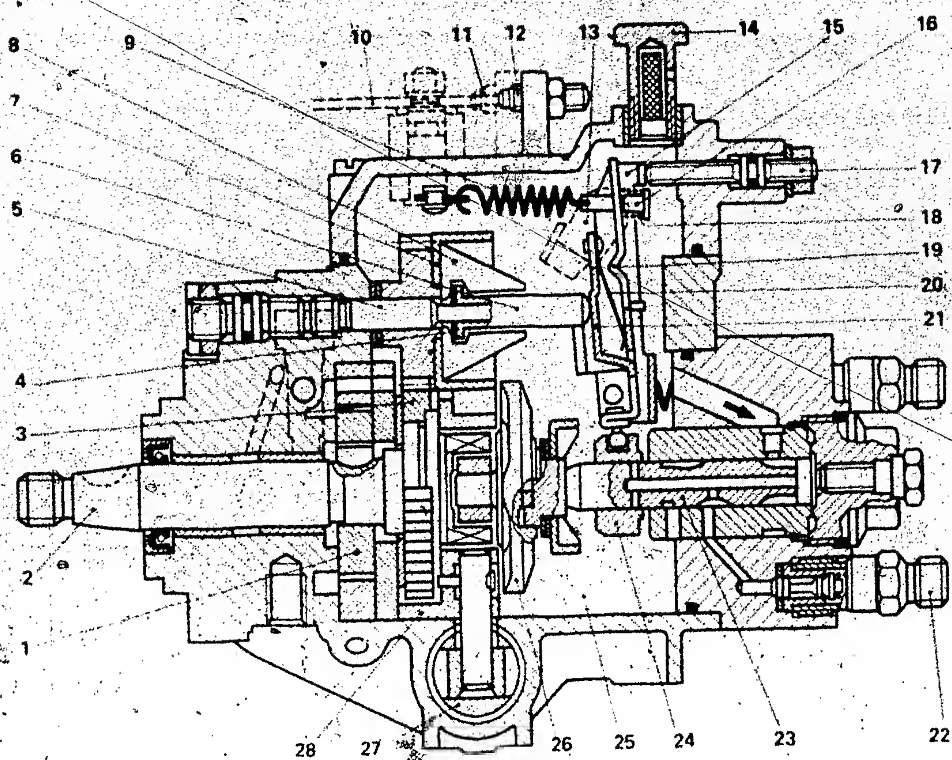


Fig. 3

2. Construction of mechanical governor (Fig. 3)

The mechanical governor is fitted on the upper side of the distributor pump.

The governor cage (7) with gear wheel is fixed on the governor spindle (5) and driven by the drive shaft (2) through a rubber buffer (vibration damper)

Four flyweights (8) are arranged in the flyweight cage and their pressure arms press through a pressure disc onto the axially-movable sliding sleeve (6). The regulating-lever group consists of starting lever (21), tensioning lever (19) and correction lever (15) The starting lever and tensioning lever pivot in the correction lever, which pivots in the pump housing An adjustment of the full-load delivery with adjustment screw (17) is thereby possible without at the same time affecting the rotational-speed control

The starting lever (21) carries a leaf spring, which serves as starting spring (20). An axially-movable retaining pin (16) with idle spring (18) at the top end of the tensioning lever (19) is suspended in the governor spring (9) The tension of the governor spring can be changed by turning the control lever (10). The starting lever (21) is provided with a spherical head on the lower end which serves to move the regulating collar (24).

3. Operation of the mechanical governor (Fig. 3)

The rotational speed of the engine is transferred by the drive shaft (2) through gears to the flyweights (8) and here converted into a centrifugal force

When the distributor pump is not working, the starting lever (21) and the regulating collar (24) are pressed by the starting spring (20) into start position. The full starting delivery is thus automatically obtained on starting

When the engine is run up to speed after starting, the sliding sleeve (6) overcomes the weak force of the starting spring (20), the starting lever (21) pushes up against the tensioning lever (19) and the starting delivery is automatically stopped by movement of the regulating plunger

At the lower idle speed the governor spring (9) is ineffective and control is taken over by the idle spring (18)

A lower or higher breakaway speed is set depending on the tension the control lever (10) has imparted to the governor spring (9). The force of the idle spring is overcome

The idle delivery is set by adjustment screw (11), the full-load delivery by adjustment screw (17)

The upper rated speed is set by adjustment screw (12).

The injection pump can be stopped electrically with an electromagnet (e.g. on the Opel) or mechanically with a stop lever (13).

When an electromagnet is used to stop the pump, the inlet port to the high-pressure chamber of the hydraulic head is closed; the electromagnet is made currentless for this purpose.

When the pump is stopped mechanically, the start lever (21) is so shifted, by an outer and an inner stop lever (13), that the regulating collar takes up a position which does not allow the spill ports to close at all.

4. Injection control (Fig. 3)

The spring-loaded timing device piston (27) is located on the underneath of the distributor pump across the axis of the pump. Depending on the supply-pump pressure, the cam roller ring (28) is turned through an adjustment mechanism and the start of injection is thus set according to the rotational speed.

If desired, a load-dependent control of the timing device can be incorporated whereby the pressure in the pump interior can be altered by a by-pass bore (in the sliding sleeve, 6) to the supply-pump suction chamber (as on the Opel).

5. Customer service note

The usual customer service is provided for these distributor pumps. Technical workshop documentation as well as test equipment and repair tools are available.

Elucidation of pump code

V E 4 / 9 F 2200 L 12

- 12 — Design number
- L — Direction of rotation R = clockwise, L = counterclockwise
- 2200 — Max. adjusted full-load speed
- F — Mechanical governor
- 9 — Piston diameter in mm
- 4 — Number of outlets
- E — Denotes power rating
- V — Distributor-type fuel injection pump

Key to part number

0 460 4 9 4 001

- 001 — Serial number
- 4 — Number of outlets
- 9 — Piston diameter 8 = 8 mm, 9 = 9 mm, 0 = 10 mm, 1 = 11 mm, 2 = 12 mm, 3 = 13 mm, 4 = 14 mm
- 4 — Number for VE injection pump
- 460 — Product class. distributor pump
- 0 — Denotes complete product

Published by

After-sales Service Training Center
Automotive Equipment (KH/VSK)

New Product

0 460 4 . .
VE . . F . . with part-load governor
and cold-start accelerator

VDT-I-460/1 B
Suppl. 1
9.1976

The operation of distributor-type fuel injection pump VE . . F . . was described in Technical Bulletin VDT-I-460/1 B.
A different version of this pump with "part-load governor" and "cold-start accelerator" has been specified and is being installed for the first time in the VW Golf and Passat models.

1. Part-load governor

In fuel-injection pumps the configurations of the intake port and spill port cross-sections give rise to certain injected fuel quantity characteristics required for the full-load curve. The result is that the injected fuel quantity increases with increasing engine speed at a constant position of the control spool.

This increasing rate-of-discharge curve is disturbing in the part-load range since the injected fuel quantity curve rises more rapidly than the fuel-requirement curve. The result is unstable governing ranges with "bucking" while driving. The performance of such a car is markedly inferior to that of a carburettor engine. The performance is again improved by using the part-load governor.

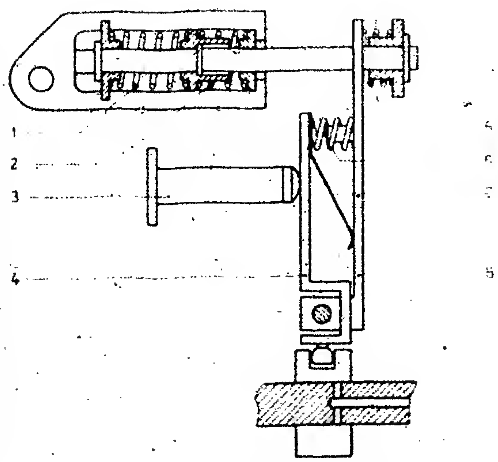
Construction of the governor

The part-load governor is mounted on the top of the distributor pump. The part-load governor comprises the main regulating spring and the part-load spring. The intermediate spring is fitted at the end of the guide pin. The idle spring and the starting spring are located between the starting lever and the tensioning lever.

Operation of the governor

The part-load governor has to regulate the injected fuel quantity in the part-load range such that it remains constant or decreases slightly at a constant accelerator pedal position. This is achieved by a part-load spring between the idle spring and the main regulating spring.

When the idle speed is exceeded, the path of the intermediate spring is traversed and the bushing and tensioning lever contact. The part-load spring then acts from this engine speed on. With increasing engine speed the spring is compressed by a certain amount, and the control spool is moved so much via the tensioning and starting levers that the injected fuel quantity does not increase at a constant accelerator pedal position but remains constant or even decreases slightly. Shortly before the maximum full-load engine speed is reached, the path of the part-load spring is traversed and the spring has no further effect.



1 = Main regulating spring
2 = Part-load spring
3 = Sliding sleeve
4 = Starting lever
5 = Intermediate spring
6 = Idle spring
7 = Starting spring
8 = Tensioning lever
9 = Control spool

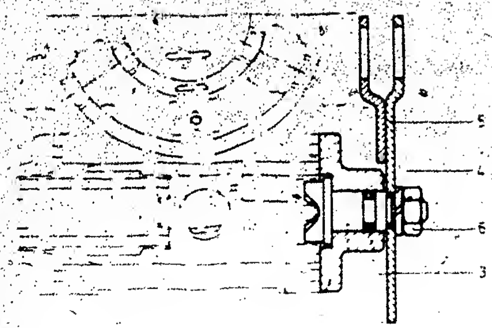
BOSCH Geschäftsbereich KH Kundendienst, Kfz-Ausrüstung
© by Robert Bosch GmbH, D-7 Stuttgart 1, Postfach 50. Printed in the Federal Republic of Germany
Imprimé en République Fédérale d'Allemagne par Robert Bosch GmbH

2. Cold-start accelerator

A further innovation as regards this distributor-type injection pump for VW is the cold-start accelerator.

The cold-start accelerator is mounted on the side opposite the timing device spring. It is cable-actuated from inside the vehicle. The timing device piston is provided with a 4 mm pin and is advanced by means of the stop lever and the shaft with the cam.

Built-in cold start accelerator



1 = Cover
2 = Shaft
3 = O-ring
4 = Spring lock washer
5 = Stop lever
6 = Hexagon nut

New Product

0 460 4 . . – VE . . F . . with manifold-pressure compensator (LDA)

VDT-I-460/1 B
Suppl. 2
10.1977

In the Technical Bulletin VDT-I-460/1 B the function of the distributor-type fuel injection pump VE .. F .. is described.
As a variant to this pump a design with manifold-pressure compensator was established.

1. Manifold-pressure compensator (LDA)

With pressure-charged engines the full-load delivery is regulated by a variable air charge in the engine cylinders dependent on the manifold pressure. In the lower rotational-speed range the air charge in the cylinders is less and the full-load delivery must correspondingly be related to the reduced air charge.

The manifold-pressure compensator serves to reduce the full-load delivery in the lower rotational-speed range starting from a determined (selectable) charge-air pressure.

2. Construction and operation of the manifold-pressure compensator

The LDA is divided into an upper and a lower chamber separated from one another by an air-tight diaphragm. In the cover of the LDA there is a connection for the charge-air pressure.

A helical compression spring operates against the diaphragm from below. This spring is supported on the other side by a threaded adjusting nut. The preload of the spring and the point at which the manifold-pressure compensator becomes effective can thus be changed.

A tapered adjusting pin is attached to the diaphragm with the aid of two plate washers.

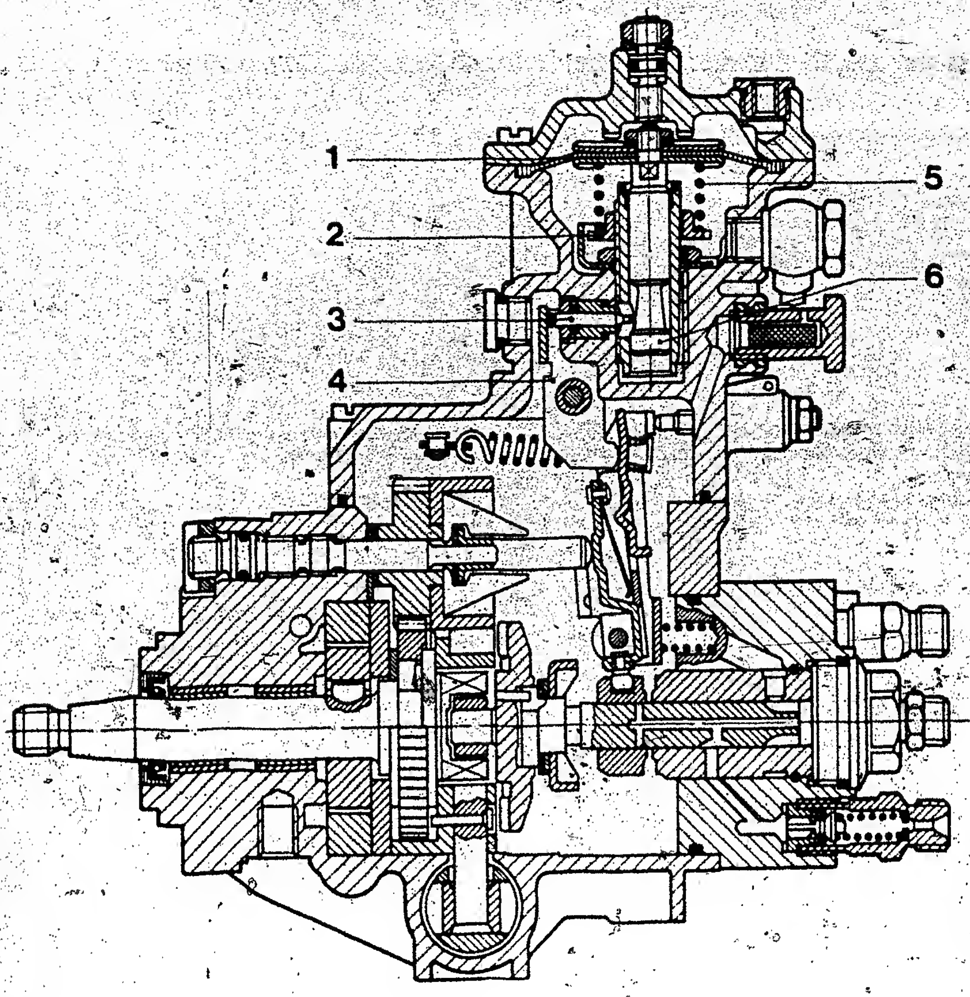
The guide pin traces the movements of the adjusting pin taper and conveys them to the compensator, the position of which is thereby altered.

If the charge-air pressure increases with a higher rotational speed, then at a certain pressure the diaphragm will be pressed down a certain amount against the force of the spring. The guide pin is pushed in the direction of the adjusting pin, whereby the compensator moves in the "greater delivery" direction.

At a lower rotational speed or when the supercharger breaks down, the compensator returns to its basic position and limits the full-load delivery such that a smokeless combustion of the fuel can be guaranteed.

BOSCH Geschäftsbereich KH, Kundendienst, Kfz-Ausrüstung
© by Robert Bosch GmbH, D-7 Stuttgart 1, Postfach 50 Printed in the Federal Republic of Germany
Imprimé en République Fédérale d'Allemagne par Robert Bosch GmbH.

H25



1 = diaphragm
2 = adjusting nut
3 = guide pin
4 = stop lever
5 = helical compression spring
6 = adjusting pin

New Product

Distributor-type fuel-injection pump VE..F.. with temperature-controlled cold-start accelerator (KSB) temperature-controlled idle-speed increase (TLA) temperature-controlled limitation of starting-fuel delivery (TAS)

1. Temperature-controlled cold-start accelerator (KSB) acting on cam roller ring

The builders of passenger car engines often retard the start of injection for the engine at normal operating temperature.

This results in the engine running more smoothly and more quietly.

However, this retarding of the start of injection may lead to difficulties in starting such engines when they are cold. Furthermore, these engines tend to run roughly and to generate smoke when cold.

The cold start accelerator has been developed to counteract this. The cold start accelerator advances the start of injection when the engine is cold.

Apart from the already known, hand-operated cold start accelerator on the timing device, there is now the temperature-dependent cold start accelerator on the cam roller ring. This offers the advantage that the start of injection is automatically controlled as a function of the cooling-water temperature and false operation is impossible.

2. Temperature-controlled idle-speed increase (TLA)

When cold, every engine has increased frictional resistance due to fits, viscocity of the engine oil etc.

The cold engine does not run smoothly at the idle speed set for the warm engine.

In order to prevent this, many types of fuel-injection pump have to date been fitted with a hand-operated stop to increase the idle speed.

Apart from the hand-operated idle stop, a temperature-dependent idle stop has been developed which controls the idle speed as a function of the cooling-water temperature or the engine temperature.

3. Temperature-controlled limitation of starting-fuel delivery (TAS)

As was stated under Point 2, every engine has increased frictional resistance when cold.

This frictional resistance calls for a relatively large starting-fuel delivery when the engine is started.

If this large starting-fuel delivery is also injected for warm or hot starts, this results in a heavy generation of smoke.

This smoke can now be prevented by the temperature-dependent limitation of the starting-fuel delivery, since the starting-fuel delivery injected into the engine always corresponds to the temperature of the engine.

H27

BOSCH
Geschäftsbereich KH, Kundendienst, Kfz-Ausrüstung
© by Robert Bosch GmbH, D-7 Stuttgart 1, Postfach 50. Printed in the Federal Republic of Germany.
Imprimé en République Fédérale d'Allemagne par Robert Bosch GmbH.

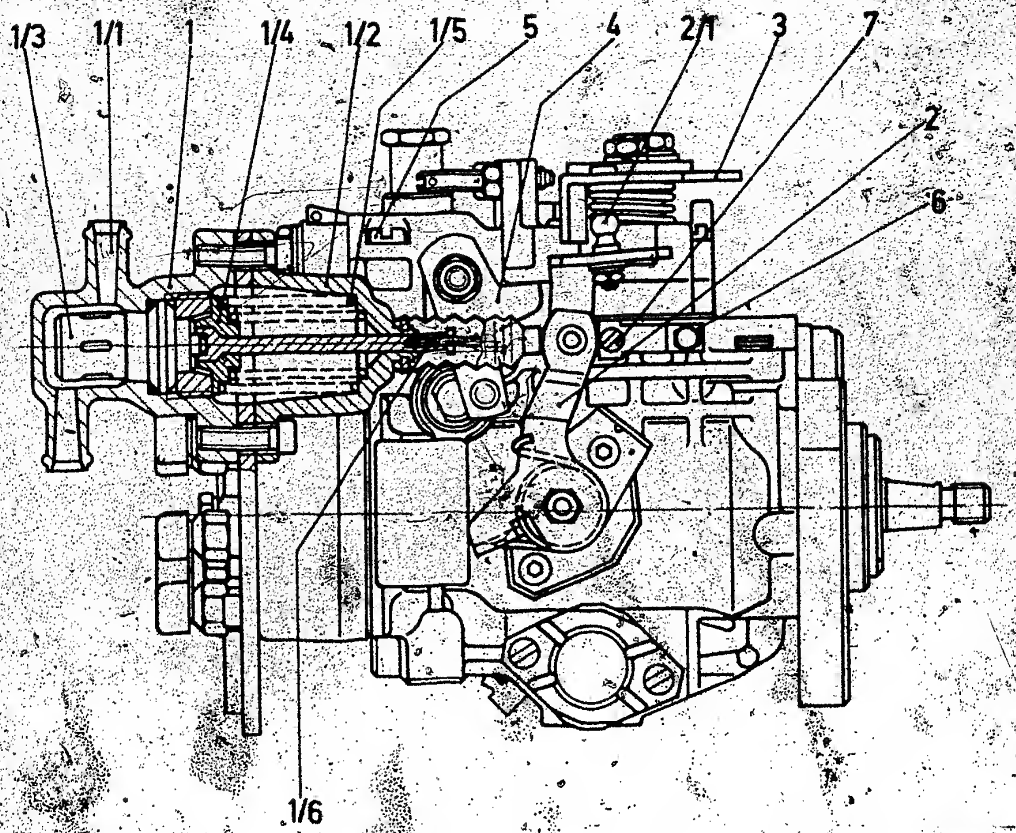


Fig. 1

1 = Control device
1/1 = Upper housing
1/2 = Lower housing
1/3 = Expansion element
1/4 = Spring seat
1/5 = Helical compression springs
1/6 = Control cable
2 = KSB control lever
2/1 = Ball stud
3 = Speed-control lever
4 = Regulating lever
5 = Stop screw
6 = Clamping piece
7 = Intermediate piece

4. Construction and operation

4.1 Construction

The temperature-dependent or temperature-controlled components are actuated by an expansion element (1/3) which is installed in the control device and is located in the engine cooling water flow. The expansion element is filled with a wax-like compound which expands when heated and actuates a pressure pin located in the expansion element.

The pressure pin changes its position depending on the temperature of the cooling water and transmits this movement via a control cable to the control lever of the KSB.

The other functions, TLA and TAS, are also controlled via the control lever of the KSB. This means that all movements of the KSB control lever are transmitted via appropriate elements to the speed-control lever of the distributor-type fuel-injection pump or to the regulating lever for limitation of the starting-fuel delivery.

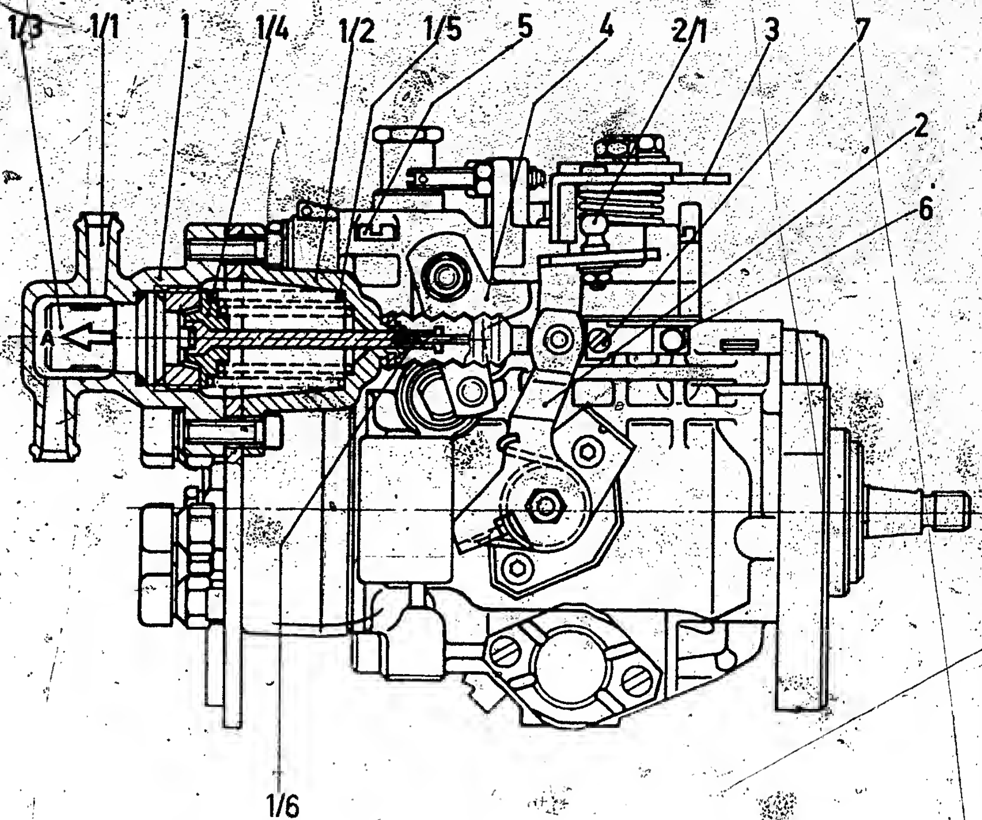


Fig. 2

1 = Control device
1/1 = Upper housing
1/2 = Lower housing
1/3 = Expansion element
1/4 = Spring seat
1/5 = Helical compression springs
1/6 = Control cable

2 = KSB control lever
2/1 = Ball stud
3 = Speed-control lever
4 = Regulating lever
5 = Stop screw
6 = Clamping piece
7 = Intermediate piece

4.2 Operation

4.2.1 Temperature-controlled cold-start accelerator (KSB)

The expansion element (1/3) is connected to the KSB control lever (2) via the spring seat (1/4) and the control cable (1/6).

If the coolant temperature of the engine drops, then the pressure pin of the expansion element moves towards **A**.

The helical compression springs (1/5) are supported on the lower housing (1/2) and the spring seat (1/4) so that the spring seat (1/4) with control cable (1/6) follows the movement of the pressure pin.

The intermediate piece (7) and the clamping piece (6) are fitted to the control cable (1/6) after the control lever (2) with the result that the control lever (2) also moves towards **A**.

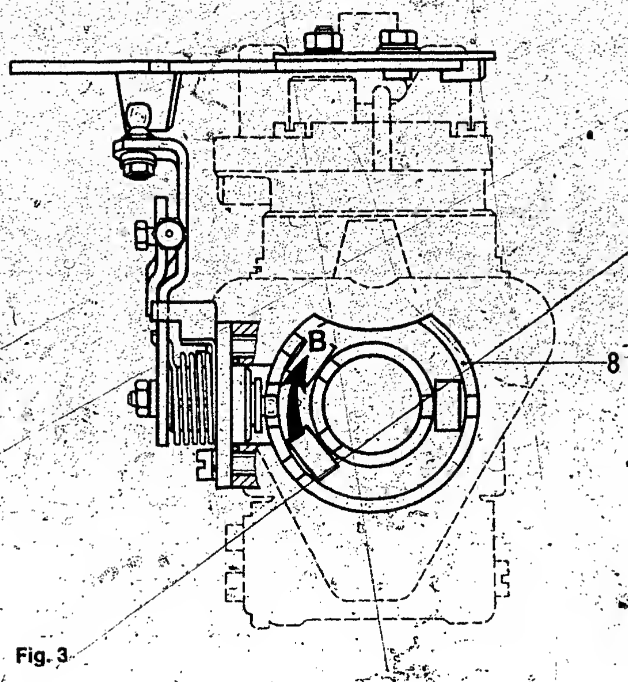


Fig. 3

8 = Cam roller ring

The control lever (2) is connected to a setting shaft, on the end face of which there is an eccentrically mounted ball stud inside the pump which projects into a recess on the cam roller ring (8).

When the control lever is moved by the control device (1) or the expansion element (1/3), then this moves the cam roller ring (8).

When the control lever (2) moves towards **A**, the cam roller ring (8) is turned towards **B** via the setting shaft of the KSB.

The start of injection is thereby advanced.

As the engine (coolant) warms up, the pressure pin of the expansion element (1/3) presses against the helical compression springs (1/5).

The control lever (2) thereby returns to its starting position. The cam roller ring (8) is again moved in the direction of "retard".

4.2.2 Temperature-controlled idle-speed increase (TLA)

If the engine temperature drops (below the operating temperature), the control lever (2) is drawn in the direction of the control device (1).

When the control lever (2) has travelled a specified distance, the ball stud (2/1) comes into contact with the speed-control lever (3).

If the engine temperature drops still further, then the control lever (2) is drawn further towards the control device.
The speed-control lever (3) thereby lifts off from the idle stop. This increases the idle speed of the engine.

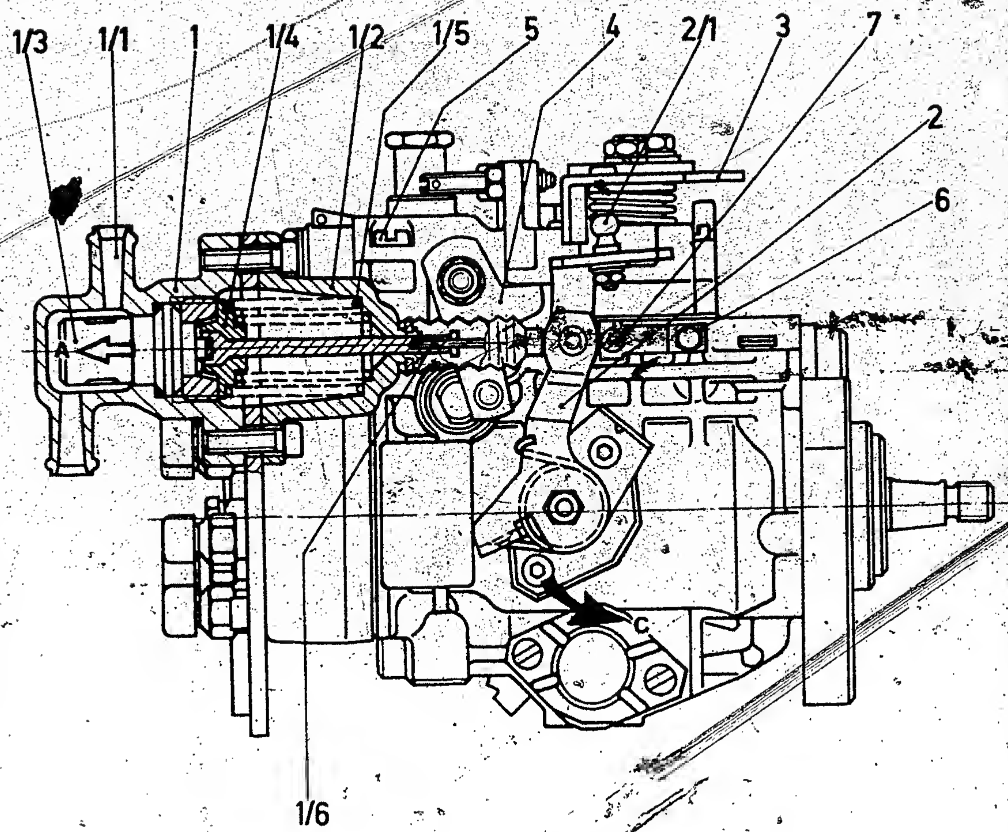


Fig. 4

1 = Control device
1/1 = Upper housing
1/2 = Lower housing
1/3 = Expansion element
1/4 = Spring seat
1/5 = Helical compression springs
1/6 = Control cable
2 = KSB control lever
2/1 = Ball stud
3 = Speed-control lever
4 = Regulating lever
5 = Stop screw
6 = Clamping piece
7 = Intermediate piece

4.2.3 Temperature-controlled limitation of starting-fuel delivery (TAS)

The regulating lever (4) is connected to the setting shaft (9) so that the setting shaft (9) follows all the rotational movements of the regulating lever in the same direction.

The end face of the setting shaft (9) is shaped in such a way that, as of a given position, it presses against the starting lever.

The regulating lever (4) is connected to the control lever (2) via a wire link.

This wire link is attached to a strap on the control lever (2).

This means that all the movements of the control lever (2) are transmitted to the regulating lever (4).

When the engine is cold, the control lever (2) has travelled its full stroke towards the control device (1).

The attachment strap on the control lever (2) swings towards **C**.

The regulating lever (4) is in its rest position, i.e. it is in contact with the fuel-injection pump cover opposite the stop screw (5).

The distributor-type fuel-injection pump delivers the maximum starting-fuel delivery for starting.

As the engine warms up, the compound in the expansion element (1/3) presses the pressure pin against the spring seat (1/4) and the helical compression springs (1/5).

The control lever (2) thereby moves towards the pump drive shaft.

The attachment strap on the control lever (2) swings in a clockwise direction, away from **C**, and presses the regulating lever (4) towards the stop screw (5).

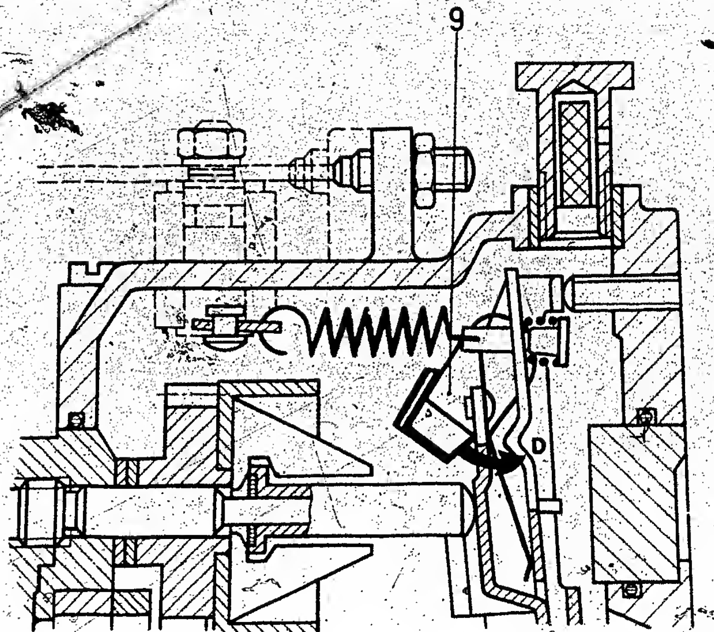


Fig. 5

9 = Setting shaft

The setting shaft (9) swings towards **D** and, after the regulating lever has travelled a given distance, contacts the starting lever of the fuel-injection pump.

As the temperature of the cooling water (engine) further increases, the starting lever is exposed to continuous pressure, thereby limiting the available starting-fuel delivery.

When the engine is at its operating temperature, the regulating lever (4) is in contact with the stop screw (5). In this position there is still a given minimum starting-fuel delivery.

New Product.

Distributor-Type Fuel-Injection Pump

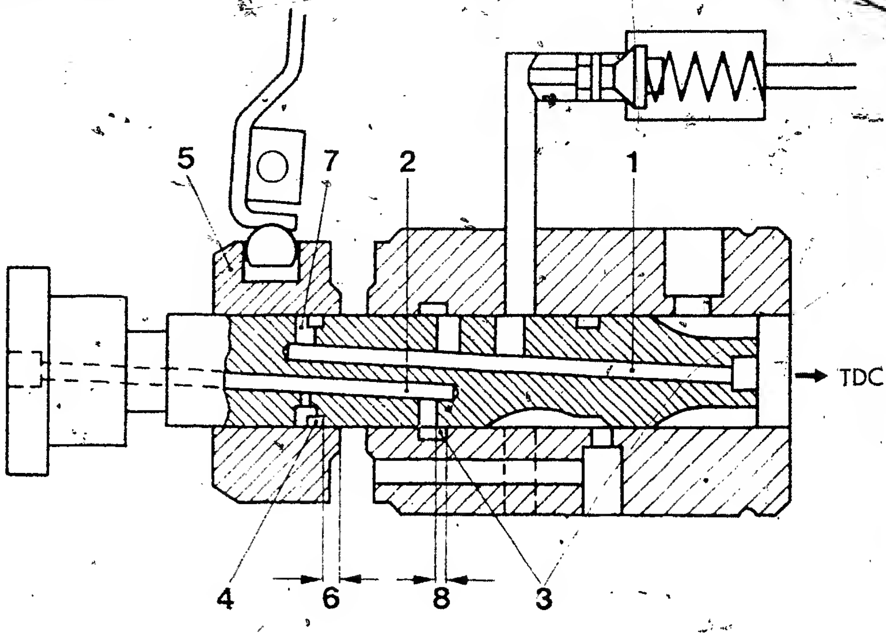
VE..F.. 0 460 4..

with quiet-idle device

The function of the VE..F.. distributor-Type fuel-injection pump is described in the Technical Bulletin VDT-I-460/1.
A model of this injection pump equipped with a quiet-idle device has now been released.

Quiet-idle device

On present-day Diesel engines, in order to improve the composition of the exhaust gas the fuel is injected into the combustion chamber in as short a time as possible, i.e. high rates of injection are used.
A high rate of injection is noticeable, depending upon system design and particularly in the idle range, in the form of idle-knock.
By increasing the duration of injection in the idle range for quieter combustion is achieved and idle-knock prevented.



J5

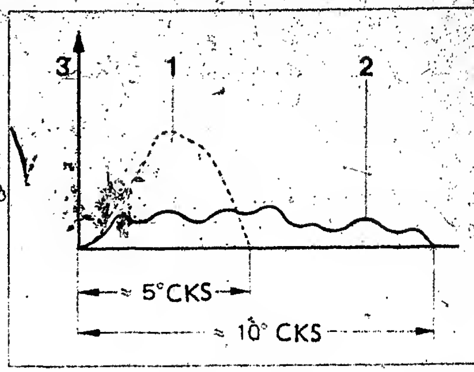
Construction and operating principle of the quiet-idle device

The plunger of the distributor-type fuelinjection pump with integrated quiet-idle device has 2 longitudinal bores (1) and (2) which are connected by an annular groove (3).

The longitudinal bore (2) has a spill section (4), under which there is a restriction, in the area of the control collar (5).

When the plunger moves in the direction of TDC, the spill section (4) belonging to longitudinal bore (2) leaves the control collar (5) earlier than the spill section (7) belonging to the longitudinal bore (1), that is, after plunger travel (6).

Due to the fact that the bores (1) and (2) are connected by the annular groove (3), part of the fuel leaks from the high-pressure chamber into the interior of the pump upon the spill section (4) leaving the control collar (5) before spill section (7).



1 = Nozzle-needle lift without quiet-idle

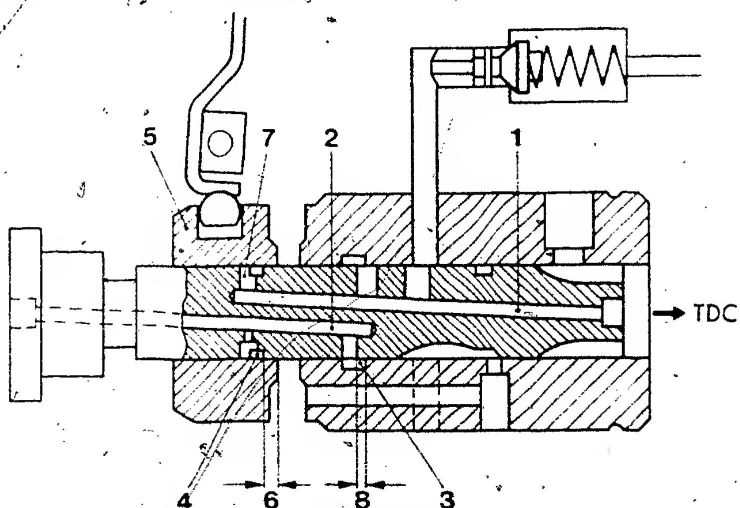
2 = Nozzle-neddle lift quiet-idle

3 = Injected fuel quantity

The result is a reduction in the rate of injection (i.e. less fuel is injected per degree crankshoft). The same quontity of fuel is injected but spread across almost twice the number of crankshaft degrees.

In the full-load range the control collar is nearer to the hydraulic head.

This means that the distance (8) is less than the distance (6). When the plunger now moves in the TDC direction, the annular groove (3) is covered before the spill section (4) emerges from the control collar (5). In other words the connection between bore (1) and (2) no longer exists, and the result is that the quiet-idle device is ineffective in the full-load range.



0 460 .. - EP/VA ..H..C..
Distributor-type fuel-injection pump with quiet-idle device

Quiet-idle device leakage test

The quiet-idle device leakage test can be carried out either in the vehicle or on the test bench.

1. Leakage test in the vehicle

1.1 The linkage between the quiet-idle device and the operating lever must be disconnected.
Note: The quiet-idle device lever must not be removed.

1.2 Remove the hose from the quiet-idle device.

1.3 Push a transparent hose onto the quiet-idle device fitting for the purpose of measuring the leakage fuel.

1.4 Position the quiet-idle device lever exactly vertically, pointing upwards towards the return fitting (see fig. 1). The quiet-idle device has thus been put out of action.

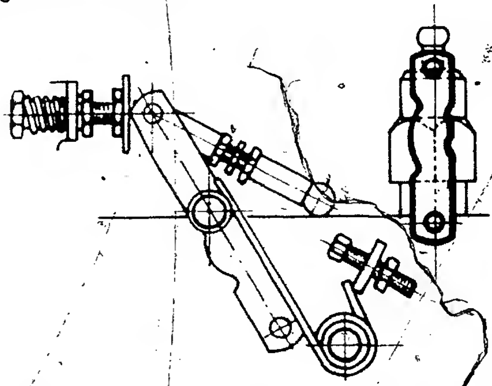
1.5 Set the engine to idle speed.

1.6 Measure the overflow quantity with a suitable measuring glass. In so doing ensure that the fuel flows uniformly out of the hose during the measurement.

1.7 Test value:
Permissible leakage quantity = max. 6 cm^3 during measurement time of 3 mins.

1.8 If the permitted value is exeeded, the quiet-idle device must be replaced.
Tightening torque for central screw plug: 40 - 60 N.m (4 - 6 kgf.m).

1.9 The linkage should be set in accordance with VDT-BMP 161/36 B.



BOSCH
Geschäftsbereich KH. Kundendienst, Kfz-Ausrüstung.
© by Robert Bosch GmbH, D-7 Stuttgart 1, Postfach 50. Printed in the Federal Republic of Germany
Imprimé en République Fédérale d'Allemagne par Robert Bosch GmbH.

J7

2. Leakage test on the test bench

2.1 The linkage between the quiet-idle device and the operating lever must be disconnected.
Note: The quiet-idle device lever must not be removed.

2.2 Push a transparent hose onto the quiet-idle device fitting for the purpose of measuring the leakage fuel.

2.3 Position the quiet-idle device lever exactly vertically, pointing upwards towards the return fitting (see fig. 1).
The quiet-idle device has thus been put out of action.

2.4 Drive the distributor-type pump at the full-load speed given under point 1.6 "full-load speed regulation" in the test specification sheet. Push the speed-control lever up against the end stop.

2.5 Measure the overflow quantity with a suitable measuring glass. In so doing ensure that the fuel flows uniformly out of the hose during the measurement.

2.6 Test value:
Permissible leakage quantity = max. 3.5 cm^3 during measurement time of 1 min.

2.7 If the permitted value is exceeded, the quiet-idle device must be replaced.
Tightening torque for central screw plug: 40 - 60 N.m (4 – 6 kgf.m).

2.8 The linkage must be set in accordance with VDT-WPP 161/4 B 1st. suppl. para. 1.-

Starting Problems in Vehicles Equipped with Distributor-type Fuel-injection Pumps VE . . F . .

Experience to date has revealed the following possible causes of starting problems in vehicles equipped with VE..F.. distributor-type fuel-injection pumps:

1. Solenoid-operated valve (item 240 in microfiche EP..) is short-circuiting to ground

   If the tightening torque for the M5 nut on the solenoid-operated valve is exceeded, there is the danger of a short-circuit to ground in the solenoid body. We therefore point out that a tightening torque of 2.5 N·m (0.25 kgf·m) should not be exceeded.

   Remedy: replace solenoid-operated valve.

2. Central screw plug (item 130 in microfiche EP..) allows leaks into the interior

   This results in a drop in starting fuel delivery.

   Remedy: Retighten the central screw plug applying a max. torque of 80 N·m (8.0 kgf·m). Investigations showed that this led to the original starting fuel delivery being re-established.
   If the tightening torque is already 80 N·m (8.0 kgf·m) the screw plug is to be replaced.
   If this measure is not successful, troubleshooting must be continued.

Vehicle agencies distributing vehicles equipped with VE..F.. distributor-type fuel-injection pumps (currently Opel, Peugeot and VW) should be made aware that the pump should not be replaced immediately whenever there are starting problems, but rather that the vehicle should be entrusted to the Bosch Service so that this central screw plug can be retightened (special wrench KDEP 1080 is required). We further request these agencies to refer to the tightening torque of 2.5 N·m (0.25 kgf·m) for the connecting cable at the solenoid-operated valve.

BOSCH
Geschäftsbereich KH. Kundendienst. Kfz-Ausrüstung.
© by Robert Bosch GmbH, D-7 Stuttgart 1, Postfach 50. Printed in the Federal Republic of Germany.
Imprimé en République Fédérale d'Allemagne par Robert Bosch GmbH.

J9

Distributor-type fuel-injection pump VE . . F . .

Modifications and notes

1. Securing and adjusting the two-piece control lever
2. New spacer sleeve for limiting full-load delivery
3. Sleeve for securing the pump cover
4. Insertion of a new seal ring (item 92)
5. New slotted shoulder screw (item 104)
6. Axial clearance of governor assembly
7. Fastening of plug, item 117 or 827 (for various versions)
8. Modified tightening torque for fastening screws (item 38) of timing device cover on spring end
9. Injection timing as per "pointer method"
10. New KDEP tools for distributor-type fuel-injection pump repairs and testing
11. Functional test of solenoid-type stop valves

The item numbers occurring in the text correspond to the service part items on microfiches.

1. Securing and adjusting the two-piece control lever

Various distributor-type fuel-injection pumps have recently been fitted with two-piece control levers.

After adjustment these control levers must be positively connected with one another. An appropriate KDEP tool is currently being developed for this purpose (KDEP 1107).

The previous single-piece control levers cannot be interchanged with the new two-piece control levers since the shaft has also been changed.

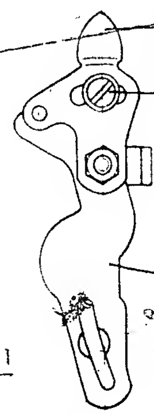


Fig. 1

Testing

For purposes of testing the distributor-type fuel-injection pump, the existing, stamped control lever is mounted such that the markings on the control lever and shaft tally.

BOSCH
Geschäftsbereich KH- Kundendienst, Kfz-Ausrüstung
© by Robert Bosch GmbH, D-7 Stuttgart 1, Postfach 50. Printed in the Federal Republic of Germany
Imprimé en République Fédérale d'Allemagne par Robert Bosch GmbH

Then set idle delivery.

Using a vice-grip wrench clamp tool KDEP 2899 to pump clamping flange in such a manner that the distance between the pump flange and center of round stamp on control lever can be measured.

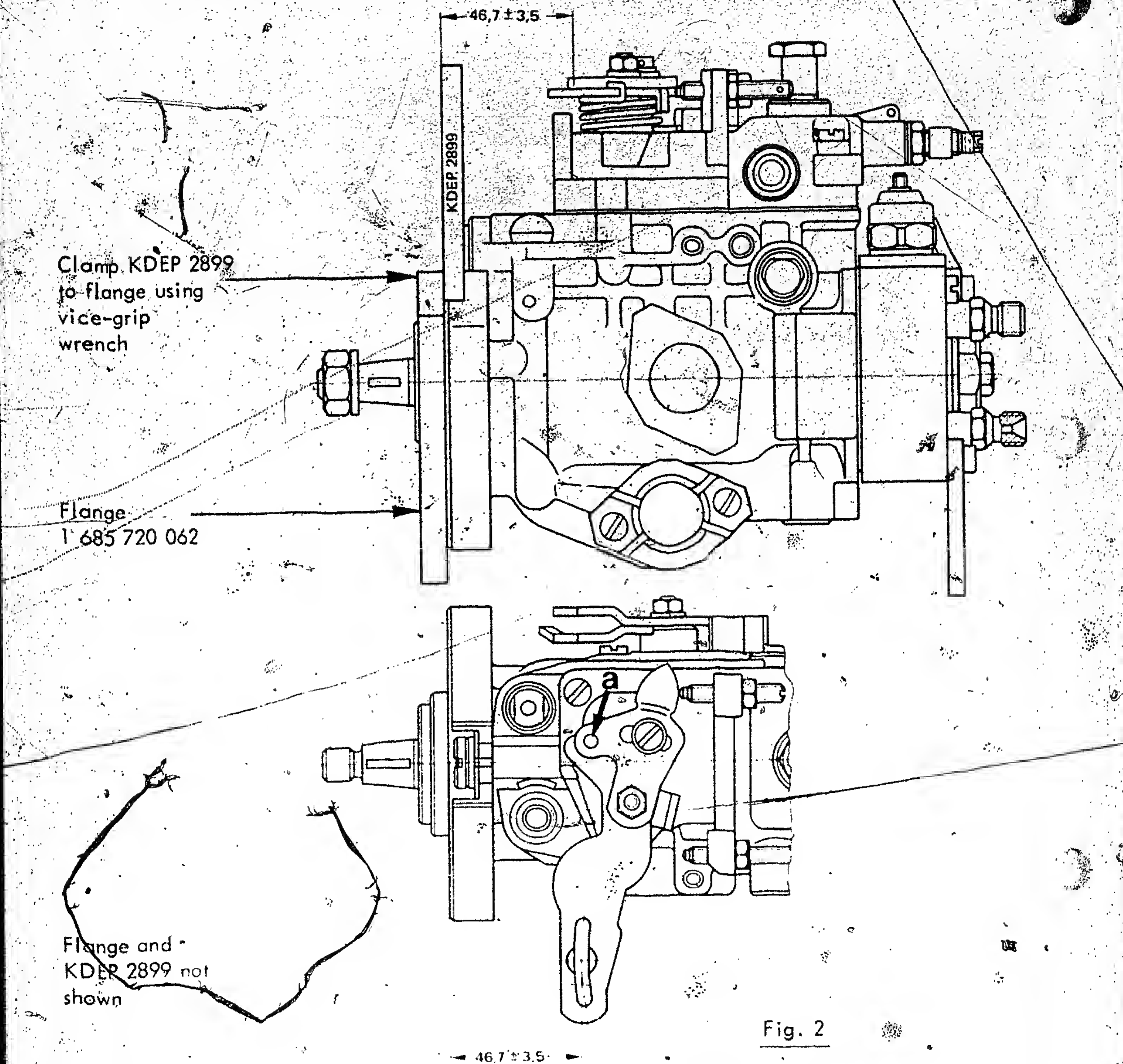


Fig. 2

Check distance between pump flange and centre of round stamp at lower oblong hole of control lever. The distance must be 46.7 ± 3.5 mm.

If the actual value is outside the permissible tolerance a new control lever base must be used.

The following procedure should be adopted:

Attach new control lever base to control-lever shaft.

Attach top of control lever in such a manner that markings on control lever and shaft tally.

J11

Screw hexagon nut with retainer onto control-lever shaft.

Insert fastening screw for both control levers and tighten slightly.

Set low-idle speed regulation in accordance with test-specification sheet. Dimension "A" does not apply.

Loosen fastening screw of control levers.

Set distance between pump flange and center of round stamp at lower oblong hole on control lever. (Fig. 2)

Tighten fastening screw. Tightening torque 6...8 Nm (0.6...0.8 kp).

Set full-load speed regulation.

Unscrew hexagon nut of control-lever shaft.

Remove complete control lever, from control-lever shaft.

The positions of the two pieces of the control lever with respect to one another should not be changed any more.

Until the stamping tool KDEP 1107 is available drill control levers at pre-drilled point (top of lever) (arrow a, Fig. 2) and rivet together or attach by means of a dowel pin. Dia. 4 mm drill.

Attach control lever to control-lever shaft such that markings on control lever and shaft tally. Recheck idle and full-load speed regulation.

2. New spacer sleeve for limiting full-load delivery

All VE..F.. distributor-type fuel-injection pumps are being provided with longer threaded pins (88) as full-load stop screws. These threaded pins are secured by way of an external spacer sleeve (93)(Fig.3). The previous internal spacer sleeve between the housing cover and threaded pin is no longer necessary.

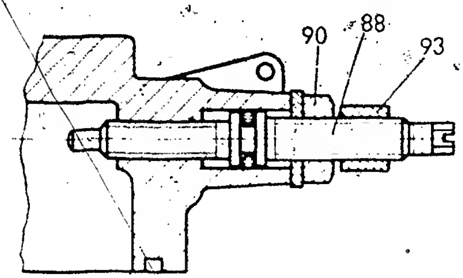


Fig. 3

The new spacer sleeve (93) cannot be removed from the threaded pin (88) and thus when performing repairs a new threaded pin and new spacer sleeve are to be used.

The new threaded pin is interchangeable. The previous threaded pins with internal spacer sleeve can be used up.

When using a new threaded pin with external spacer sleeve the following procedure is to be adopted for test purposes (full-load limiting):

Preset full-load delivery.

Push new spacer sleeve onto threaded pin until contact is made with locknut (90).

Guide stamping tool KDEP 1106 over spacer sleeve until contact is made with locknut (90). Insert stamping screw by hand until it touches spacer sleeve, then give a further 1 1/2 - 1 3/4 turns.

Unscrew stamping screw and remove stamping tool.

There should be no gap between spacer sleeve and locknut.

3. Sleeve for securing the pump cover

All distributor-type fuel-injection pumps VE..F.. have a fixture between the housing cover or manifold-pressure compensator housing and the pump housing.

The fixture consists of a fi[illegible] sleeve on the mounting hole next to the full-load stop.

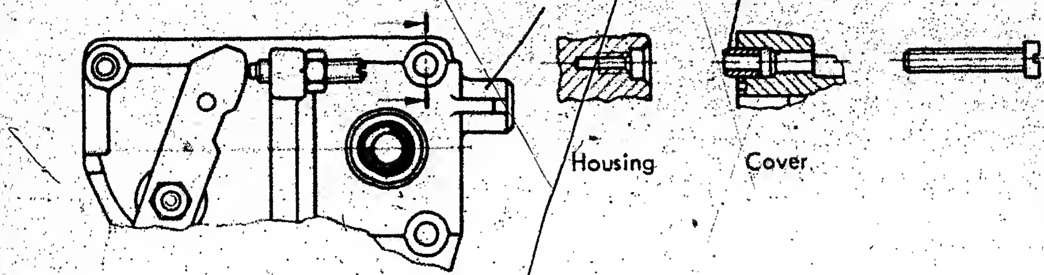


Fig. 4

When equipping previous pumps with new covers the fitting sleeve is to be removed.

4. Insertion of a new seal ring (92)

The seal ring (92) of the housing cover will in future have 12 "tabs" around the edge. These tabs are designed to prevent the seal ring from falling out when mounting the housing cover. The previous seal rings can be used up.

5. New slotted shoulder screw (104)

The slotted shoulder screws on the sides of all distributor-type fuel-injection pumps VE..F.. have been changed from hexagon bolts to tamperproof triangle-head bolts (Fig. 5). These slotted shoulder screws are designed to support the fulcrum levers.

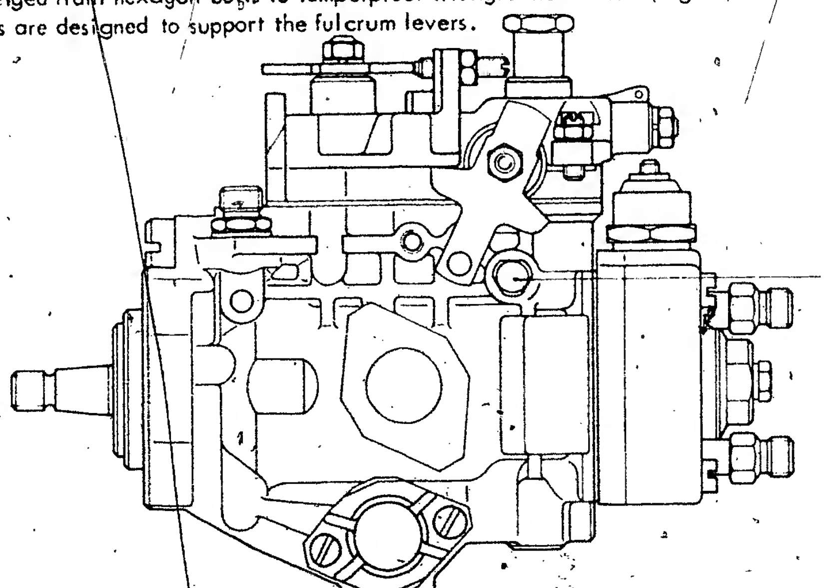


Fig. 5

The socket wrench KDEP 1087 must be used for tightening/loosening the slotted shoulder screws.

6. Axiol clearance of governor assembly

The foct that the oxial clearonce of the governor assembly had been increased to 0.35...0.55 mm was published in Technicol Bulletin VDT-I-460/105.

Since then this increased axiol clearance has repeatedly been quoted as being the cause of various vehicle defects.

Specific tests have shown that the axial clearance of the governor assembly has no influence on the smooth running of the engine nor on vehicle handling.

The stop pin for the governor assembly is merely designed to prevent the weight of the governor assembly overcompressing the starting spring if the pump (or vehicle) is inclined.

7. Fastening of plug, item 117 or 827 (for various versions)

The tab washer 1 461 290 301 is now used for fastening these plugs instead of the retoiner 1 464 601 301. The use of the retainer or tob washer depends on the plug design. The retainer is still avoiloble under the part number 1 464 601 301.

8. Modified tightening torque for fastening screws (38) of timing device cover on spring end

The tightening torque for the above-mentioned fastening screws has been changed from 6...8 Nm (0.6 ... 0.8 kpm) to 5.. . 6 Nm (0.5 ... 0.6 kpm).

In the case of fuel-injection pumps with flot-head screws the tightening torque is 8...10 Nm (0.8 ... 1.0 kpm).

9. Injection timing os per "pointer method"

Various distributor-type fuel-injection pumps VE..F.. are fitted with a side inspection window.

The pointer is set as follows:

Proceed as per repair instructions up to and including "adjustment of plunger lift to port closing".

Switch off test bench but do not dismantle fuel-injection pump.

Remove cover of inspection window.

Turn drive shoft in direction of rotation of pump until mark on cam plate is visible. The Woodruff key slot in the drive shaft points towards the delivery outlet.

Continue turning slowly until required lift as per test specification sheet is achieved.

In this position move pointer until it tallies with mark on cam plate.

Turn drive shaft back and recheck setting.

Mount closing cover of inspection window.

Remove plunger lift to port closing measuring tool and remove fuel-injection pump from test bench.

Proceed as per repair instructions.

For engine mounting the measuring tool KDEP 1085 can be used as a check.

10. New KDEP tools for distributor-type fuel-injection pump repairs and testing

All special tools previously intended for user manufacture have been incorporated into the KDEP tool range and are contained in the new tool board KD-VA-Z (cf. catalogue sheet KD-EP 9 D 11.77).

11. Functional test of solenoid-type stop valves

A functional test of the solenoid valves must be performed after installation.

If a functional test is performed when the valves are not fitted cooling is insufficient and damage to the solenoid valves cannot be excluded.

DISTRIBUTOR-TYPE FUEL-INJECTION PUMP

VA.. 0 460 3..

VDT-I-460/113 En
11.1979

Change in gasket for delivery-valve assembly

As from FD 930, all distributor-type fuel-injection pumps type VA..C.. will be equipped with bronze gaskets 1 460 105 302 (Item 83 in the Service Parts List) instead of the copper gaskets used previously.

For all distributor-type fuel-injection pumps type VA..C.. with bronze gaskets, the tightening torque of the delivery-valve holder is increased from 35 ... 45 Nm to 45 ... 55 Nm.

Bronze gaskets can be fitted during repairs on VA..C.. distributor pumps having an older FD.

It is to be noted that only gaskets of the same material are to be used on the same hydraulic head. The delivery-valve holders must be tightened with the appropriate torque.

Note

The copper gaskets will continue to be fitted on distributor pumps type VA.. up to and including the B-version, and the tightening torque of 35 ... 45 Nm will be retained for the delivery-valve holder.

BOSCH Geschäftsbereich KH Kundendienst Kfz-Ausrüstung
© by Robert Bosch GmbH, D-7 Stuttgart 1, Postfach 50 Printed in the Federal Republic of Germany
Imprimé en République Fédérale d'Allemagne par Robert Bosch GmbH

J16

TIMING-DEVICE MODIFICATION

on VA 6/100 F 1000 CR 199 or CR 199 P

(IHC engine D 310)

VDT-I-460/121 En

2.1981

In order to prevent misfiring and the formation of white smoke on International Harvester tractors fitted with the D 310 engine, the VA 6/100 H 1000 CR 199 and the CR 199 P distributor-type fuel-injection pumps have been modified by increasing the timing-device adjustment range by 3°.

Until FD 922 (date of manufacture Feb. 1979), the timing-device piston was adjusted with a setting of 3° "advance". In order to shift the nominal start of pump delivery to 6° "advance", a shim was fitted between the spring cover of the timing device and the housing. A different spring (Item No. 26 on the Service Parts List, Part Number 1 464 618 005) was also fitted. These modified pumps are marked as follows: VA... CR 199 A or CR 199 PA:

As from FD 922, distributor pumps are delivered ex-works with the timing-device piston and the spring (but without shim) already set to 6° "advance". Modified distributor pumps with the code VA 6...199A which are received by service stations and which require a thorough overhaul, must be fitted with a new housing and new timing-device piston (Part Number 1 456 120 983) whereby the shim is to be removed.

Warranty:

Costs are to be borne by the customer. Warranty claims cannot be accepted.

Geschäftsbereich KH, Kundendienst, Kfz-Ausrüstung.

DISTRIBUTOR-TYPE FUEL-INJECTION PUMP

EP/VE...F 0 460 4.. ...

VDT-I-460/122 En

2.1981

In distributor-type fuel-injection pumps VE...F with two-part control lever (double spring combination), the control lever does not always return to the idle stop. The cause of the fault is the lack of lubricating grease on the spring, stop bushing and cover.

Remedy:

The lubricating grease on the control lever must not be washed away. Whenever the engine is washed this area must be relubricated with multi-grade grease or at least with engine oil.

It is necessary to lubricate both return springs and the the lower stop bushing when any after-sales service work or repairs are carried out.

BOSCH

Geschäftsbereich KH. Kundendienst. Kfz-Ausrüstung.

TABLE OF CONTENTS

SOMMAIRE

CONTENIDO

Fig. 1

Fig. 4

Fig. 2

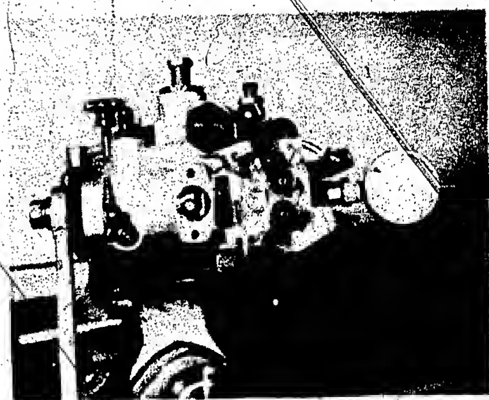


Fig. 5

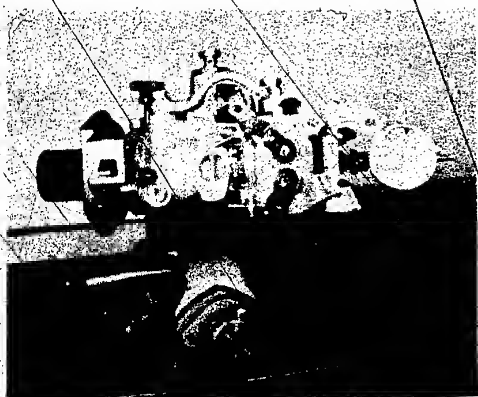


Fig. 3

Fig. 6

1.1 "Dial-indicator method"

1.1.1 Preparing the injection pump (Fig. 1)

Remove the central screw plug (vent screw) from the distributor head. The distributor groove on the plunger is now visible and must be set in the direction of the "delivery" outlet.

Install the dial indicator holder 1 688 130 044 (EFEP 466) with gasket in place of the central screw plug. Fit dial indicator 1 687 233 011 (EFAW 7) and in BDC position of the face cam preload approx. 5 mm (0.197 in.) and set it to zero.

Rotate the drive shaft in the direction of rotation until the dial indicator shows the reading given on the relevant pump Test Sheet for (Position for beginning of delivery at plunger stroke ... mm)

Lock the drive shaft in position with lock screw 1 683 453 001 (EFSR 24 Y 3 Z). For this purpose, a bore is provided on the flange between the tubing connections.

1.1.2 Preparing the engine

Set the engine to the delivery timing mark provided by the manufacturer.

1.1.3 Installation of the pump (Fig. 2)

Locate and fasten the pump. Pay attention that the pump is fixed centrally in its long flange slots. Remove the lock screw and re-install the plug.

Then correct (Position for beginning of delivery at plunger stroke ... mm) setting and secure the pump. Remove the dial indicator holder and re-install the plug.

N. B. If the pump has to be installed without using the lock screw allowance must be made for a matching drift angle on the engine (see 1.1.2).

1.2 "Marking method"

1.2.1 Preparing the injection pump (Fig. 3)

Remove the central screw plug (vent screw) from the distributor head. The distributor groove on the plunger is now visible and must be set in the direction of the "delivery" outlet.

Install the dial indicator holder 1 688 130 044 (EFEP 466) with gasket in place of the central screw plug. Fit dial indicator 1 687 233 011 (EFAW 7) and in BDC position of the face cam preload approx. 5 mm (0.197 in.) and set it to zero.

Rotate the drive shaft in the direction of rotation until the dial indicator shows the reading given on the relevant pump Test Sheet for (Marking for beginning of delivery at plunger stroke ... mm and ... angle on the marking device)

Lock the drive shaft in position with lock screw 1 683 453 001 (EFSR 24 Y 3 Z). For this purpose, a bore is provided on the flange between the tubing connections.

Set marking device EFEP 464 to the angle specified on the Test Sheet, fasten it on the drive shaft and mark the flange. Thereafter, remove the marking device, dial indicator holder and lock screw and re-install the plugs.

1.2.2 Preparing the engine

A "missing-tooth" pinion is used to couple the engine with the injection pump. In this case, the engine manufacturer has made a mark (Beginning of delivery) on the mounting flange for the injection pump.

1.2.3 Installation of the pump (Fig. 4)

Insert the injection pump and twist it until the marks coincide. Fasten the pump.

1.3 "Pointer method"

1.3.1 Preparing the injection pump (Fig. 5)

Remove the central screw plug (vent screw) from the distributor head. The distributor groove on the plunger is now visible and must be set in the direction of the "delivery" outlet.

Install the dial indicator holder 1 688 130 044 (EFEP 466) with gasket in place of the central screw plug. Fit dial indicator 1 687 233 011 (EFAW 7) and in BDC position of the face cam preload approx. 5 mm (0.197 in.) and set it to zero.

Rotate the drive shaft in the direction of rotation until the dial indicator shows the reading given on the relevant pump Test Sheet for

(Pointer setting for beginning of delivery at plunger stroke ... mm)

Lock the drive shaft in position with lock screw 1 683 453 001 (EFSR 24 Y 3 Z). For this purpose, a bore is provided on the flange between the tubing connections.

Set the adjustment pointer on the roller ring to coincide with the mark on the face cam. Remove the dial indicator holder and re-install the plug.

N. B.: There may be 2 marks on the face cam, the one marked "L" being for a counter-clockwise rotating pump.

1.3.2 Preparing the engine

Set the engine to the timing mark (Beginning of delivery) provided by the manufacturer.

1.3.3 Installation of the pump (Fig. 6)

Insert the injection pump and fasten it. Pay attention that the pump is fixed centrally in the long flange slots. Remove the lock screw and re-install the plug.

Thereafter correct the adjustment (the adjustment pointer must coincide with the corresponding mark on the face cam) and secure the pump. Close the inspection hole.

N. B. If the pump has to be installed without using the lock screw, allowance must be made for a matching drift angle on the engine (see 1.3.2).

2. Venting the injection system

2.1 After the pump is installed, fill it with filtered fuel.

2.2 Vent the fine filter at the vent screw until bubble-free fuel leaks out.

2.3 Vent the pump at the vent screw on the inlet to the distributor head until bubble-free fuel leaks out.

2.4 Vent the pressure chamber in the distributor head at the vent screw (central screw plug) until bubble-free fuel leaks out.

N. B. After the installation steps, it may happen that the pump is set on a delivery stroke and there is no connection between the suction chamber and the pressure chamber; therefore no fuel can leak through the vent screw. In this case, the pump has to be rotated a little farther.

When tightening the vent screw (central screw plug), pay attention that the gasket fits perfectly on the distributor head and that the vent screw is tightened with a torque of 4.5 - 5.5 kgm (32.5 - 39.8 ft. lb.).

2.5 Connect up the high-pressure lines according to the injection sequence. It is recommended that they are tightened only on the pump at first and that the engine is then cranked over to fill them. Thereafter connect up the high-pressure lines to the nozzle holders.

REPAIRING AND TESTING NOZZLE-AND-HOLDER ASSEMBLIES

supersedes WJP- 320/2
W - 432/300
W -433/300 Suppl. 1
W -433/301
W -434/300
I -434/1

1. General instructions

Nozzle-holder assemblies and nozzles are products manufactured with maximum precision. For that reason, watch for maximum cleanliness in all working and at the job site.

When it becomes dirty, replace the test oil per ISO 4113 with new test oil. In so doing, also take out and replace the filter element in the nozzle tester. After filling the new test oil in, purge in the inside of the instrument by operating the hand lever. In so doing, spray into the open, without having attached a nozzle-and-holder assembly.

Check the pressure gauge once a month with a more accurate comparison pressure gauge!

Be certain to use only the plunger-and-barrel assemblies, delivery-valve assemblies, and test pressure lines listed in the service parts list for the nozzle tester because different test preconditions result if other parts are used.

1.1 Instructions for the chatter test and spray test

When evaluating the nozzles, distinguish between new and used nozzles. Do not run the chatter test and spray test simultaneously!
Switch off the pressure gauge of the nozzle tester by closing the shutoff valve. This is necessary to protect the pressure gauge.
New nozzles:
The chatter test makes it possible to test by listening the ease of movement for the needle valve in the nozzle body. The readiness with which new nozzles chatter depends upon the following dimensions:
The diameters of the seat, guide, and blind hole. These determine groups of chatter characteristics that reproduce the chatter behavior of the nozzles.
If the nozzle does not chatter in spite of a cleaning, it is to be replaced with a new nozzle. The shape of the spray jet is not of importance in the chatter test.
A spray pattern conforming to specifications is present generally only on new nozzles.
Used nozzles:
The chatter behavior of the nozzle deteriorates due to wear in the seat region. For that reason, do not use the groups of chatter characteristics here. When the lever is moved quickly, the nozzle must chatter audibly and/or spray with good atomization. For used nozzles, the spray pattern can deviate from the ideal shape for the new nozzle. It is not possible in every instance to conclude that there is a negative effect on the operation of the engine from this. The spray pattern of such nozzles can, however, be perceptibly improved by means of appropriate cleaning actions.

1.2 Test instructions and test specifications for opening pressure

The opening pressure prescribed for a nozzle-and-holder assembly is stamped in in many cases on the nozzle-holder body.
If that is not the case, determine the value from the appropriate documents from the manufacturer of the engine. Generally, the tolerance for setting is $\pm$ 8 bar.

For the DDAD (GMC/Chevrolet) nozzle-and-holder assemblies 0 432 217 081, 0 432 217 092, and 0 432 217 104, the following values apply:

When newly set: 125 $\pm$ 10 bar

When checking: min. 105 bar

2. Safety regulations

When working on the nozzle tester, observe the following:

Keep your hands away from the nozzle jet!

The jet from a nozzle penetrates deeply into the flesh of the finger or the hand, and destroys the tissue. The test oil penetrating into the blood can cause blood poisoning.

3. Tightening torques for assembly and installation

Screwed connection	Type c		
	KBAL(Z)..P.. Nm	KDAL(Z)..P.. Nm	KBEL(Z)..P.. Nm
Nozzle-retaining nut	30...40	40...40	40...50
Union nut for the delivery line	15...25	15...25	15...25
Inlet connector in the holder body	-	-	30...45
Inlet-union screw for leakage connection	2...4	2...4	1)
Tube fitting for leakage connection	-	-	-
Union nut for leakage connection	-	-	-
Inlet-union screw for cooling oil connection	-	-	-
Screw plug	-	-	-
Locking nut for setting screw	-	-	-
Cap nut	-	-	-

1) Thread M6x1 = Tightening torque = 2...4 Nm
Thread M8x1 = Tightening torque = 4...6 Nm
Thread M10x1 = Tightening torque = 6...8 Nm

f nozzle-and-holder assembly

	KDEL(Z)..P.. Nm	KBEL(Z)..S.. Nm	KDEL(Z)..S.. Nm	KB(L)..S.. Nm
	40...50	50...70	50...70	70...90
	15...25	15...25	15...25	15...25
	30...45	30...45	30...45	45...65
	1)	1)	1)	1)
	-	-	-	-
	-	-	-	-
	-	-	-	-
	-	-	-	60...90
	-	-	-	5...15
	-	-	-	40...60

Tightening torques for assembly and installation (continued)

Screwed connection	Type of r		
	KBAL(Z)..S.. Nm	KDAL(Z)..S.. Nm	KCA..S.. Nm
Nozzle-retaining nut	70...90	70...90	70...90
Union nut for the delivery line	15...25	15...25	15...25
Inlet connector in the holder body	2) 45...65	2) 45...65	-
Inlet-union screw for leakage connection	1)	1)	-
Tube fitting for leakage connection	-	-	-
Union nut for leakage connection	-	-	-
Inlet-union screw for cooling oil connection	-	-	-
Screw plug	-	-	-
Locking nut for setting screw	-	-	-
Cap nut	-	-	-

1) Thread M6x1 = Tightening torque = 2...4 Nm
Thread M8x1 = Tightening torque = 4...6 Nm
Thread M10x1 = Tightening torque = 6...8 Nm

2) For nozzle-holder assemblies with a through stem (with no head
tightening torque = 30...45 Nm.

3) For inlet connectors with connection thread M 22x1.5, the tight

ozzle-and-holder assembly

KB..TA.. Nm	KBF..T.. Nm	KB..U.. Nm	KBF..U.. Nm
100...140	100...140	200...220	200...220
20...30	20...30	60...80	60...80
3) 90...110	3) 90...110	120...140	120...140
1)	1)	1)	1)
-	-	50...60	-
-	-	2...8	-
-	30...40	-	30...40
60...90	60...90	80...100	80...100
10...20	5...10	30...40	10...20
40...60	40...60	50...70	50...70

ressed on) and inlet connectors screwed on at the side,

ening torque is 120...140 Nm

Tightening torques for assembly and installation (continued)

Screwed connection	Type of		
	KBAL(Z)..P.. Nm	KDAL(Z)..P.. Nm	KBEL(Z)..P.. Nm
Screws for fastening flange 4)	10...20	-	10...20
Nozzle-holder assembly in the cylinder head	-	-	-
Retaining screw in cylinder head	-	50...60	-

Screwed connection	Type of		
	KBAL(Z)..P.. Nm	KDAL(Z)..P.. Nm	KCA..S.. Nm
Screws for fastening flange 4)	10...20	-	-
Nozzle-holder assembly in the cylinder head	-	-	60...80
Retaining screw in cylinder head	-	60...80	-

4) For claw-type fastening, follow the manual of the manufacturer

nozzle-and-holder assembly

	KDEL(Z)..P.. Nm	KBEL(Z)..S.. Nm	KDEL(Z)..S.. Nm	KB(L)..S.. Nm
	-	10...20	-	10...20
	-	-	-	-
	60...80	-	60...80	-

nozzle-and-holder assembly

	KB..TA.. Nm	KBF..T.. Nm	KB..U.. Nm	KBF..U.. Nm
	-	-	-	-
	-	-	-	-
	-	-	-	-

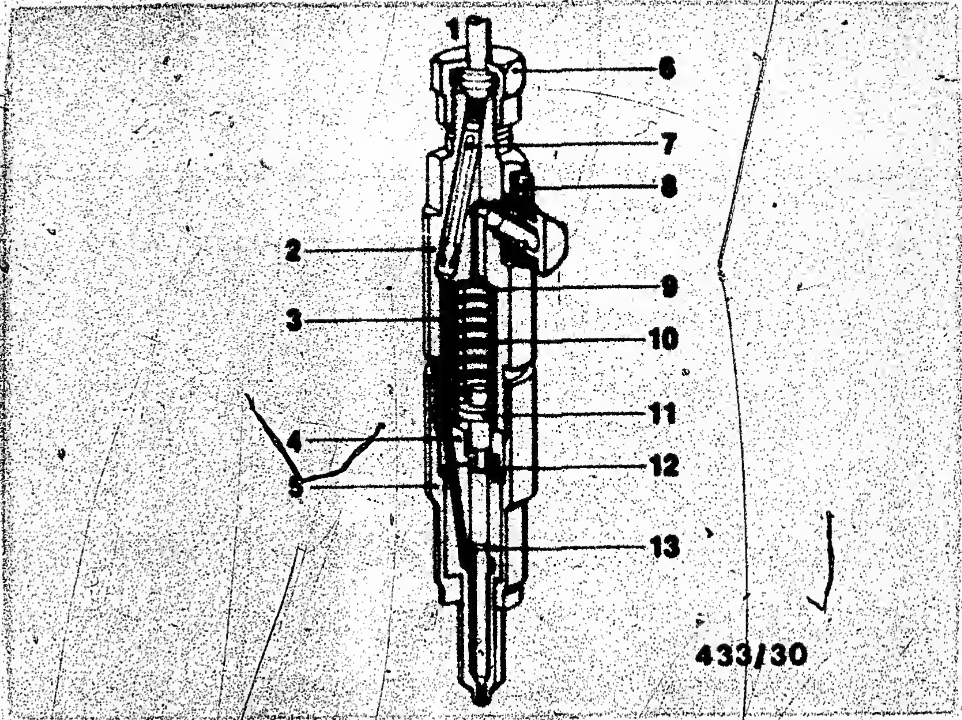
of the engine!

4. Tools and equipment, test oil

Nozzle-cleaning kit	KDEP 2900	
Mounting tool	KDEP 1043 *)	
Illuminating magnifier	0 681 104 000	
Nozzle tester	0 681 200 502	
Needle valve tester	1 688 130 153	
Quick-clamping device	0 681 243 006	for nozzles of size R
Quick-clamping device	0 681 243 003	for nozzles of size S
Quick-clamping device	0 681 243 004	for nozzles of size T
Universal nozzle-holder assembly	0 431 101 010	for nozzles of size R
Universal nozzle-holder assembly	0 681 243 005	for nozzles of size S
Universal nozzle-holder assembly	0 681 343 002	for nozzles of size T

Test oil per ISO 4113, or diesel fuel

*) An appropriate hole is to be put into the support plate KDEP 1043/0/1 on older mounting devices to accommodate the KCA holders.



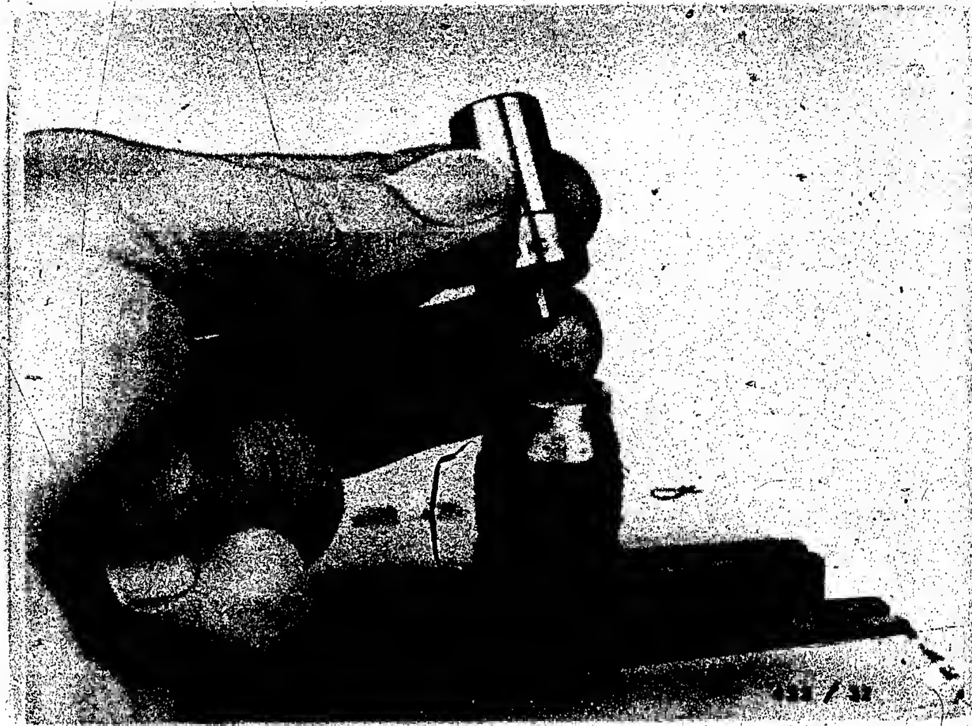
1 = Inlet
2 = Supporting device
3 = Pressure channel
4 = Intermediate disc
5 = Nozzle-retaining nut
6 = Union nut for delivery line
7 = Edge-type filter
8 = Fuel leakage connection
9 = Pressure-adjusting shims
10 = Pressure spring
11 = Thrust pin
12 = Locking pins (to hold the nozzles in place)
13 = Injection nozzle

Cross-section, nozzle-holder assem. KDAL

433/31

6. Dismantling the KCA nozzle-and-holder assembly

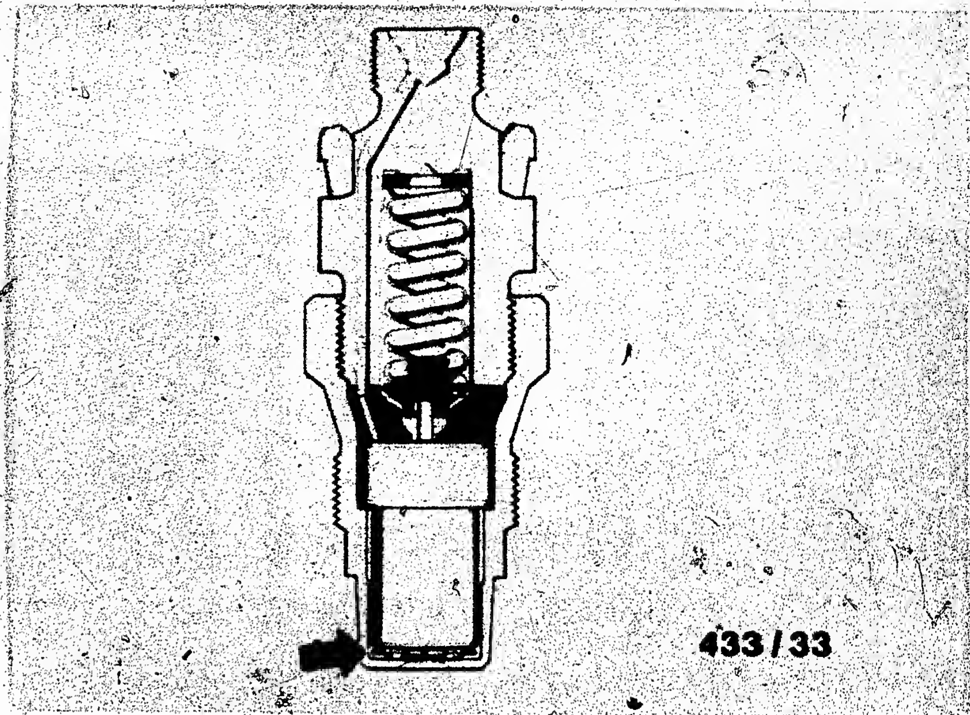
Take the complete nozzle-and-holder assembly out of the engine and, before dismantling it, check it on the nozzle tester. If need be, lay it in a cold cleaning solution, and clean the outside with the parts of the nozzle cleaning kit KDEP 2900 provided for that purpose.



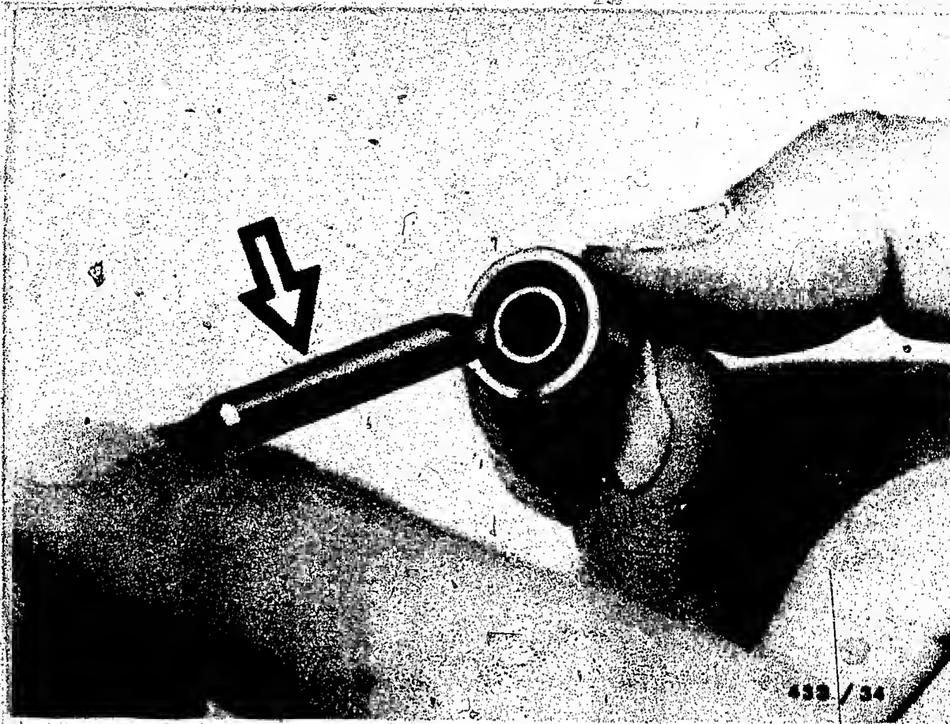
Clamp the complete nozzle-and-holder assembly in the vise (using protective jaws!) in such a way that the nozzle points up.

Release the nozzle-retaining nut and unscrew it.

Take out the nozzle, the intermediate disc, the thrust pin, the pressure spring, and the shim plate from the holder and lay them to one side. (Do not damage the seal surface.)



In the case of nozzle-and-holder assemblies with a thermal protection disc inserted in the nozzle-retaining nut (arrow), that disc must in every case be taken out and replaced with a new one.



6.1 Cleaning

When the nozzle-holder assembly has been taken apart, clean the individual parts with a cold cleaning solution.
Clean new nozzles in diesel fuel or test oil per ISO 4113. Clean dirt and residues of combustion from used nozzles with the nozzle-cleaning kit KDEP 2900. (See the Figure, arrow.) Then wash them out in the cold cleaning solution.

For the needle valves of hole-type pintle nozzles, depending on the diameter of the hole, combustion residues are removed from the longitudinal hole in the pintle using cleaning needle KDEP 2900/5 (needle diameter 0.18 mm for hole diameter 0.20 mm) or KDEP 2900/3 (needle diameter 0.15 mm for hole diameter 0.18 mm). Clean the transverse hole using cleaning needle KDEP 2900/13. Then dip the needle valves into clean test oil or diesel fuel and insert them into the nozzle body.

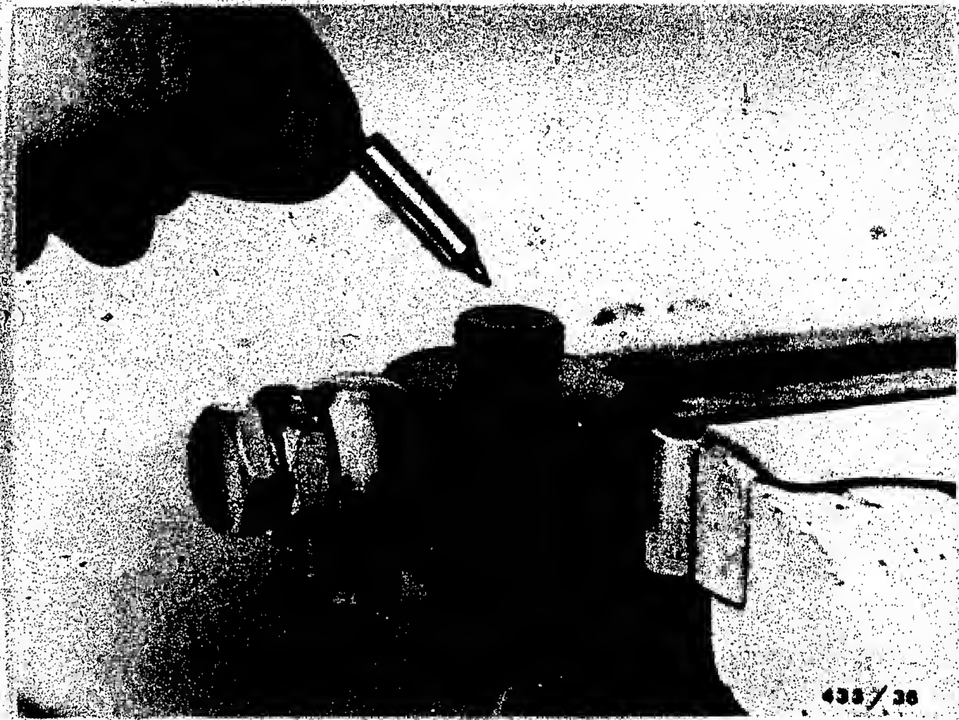
6.2 Visual inspection - pintle nozzles

After cleaning, subject used nozzles to a visual inspection.

In that inspection, the following are not permissible on the needle valve:

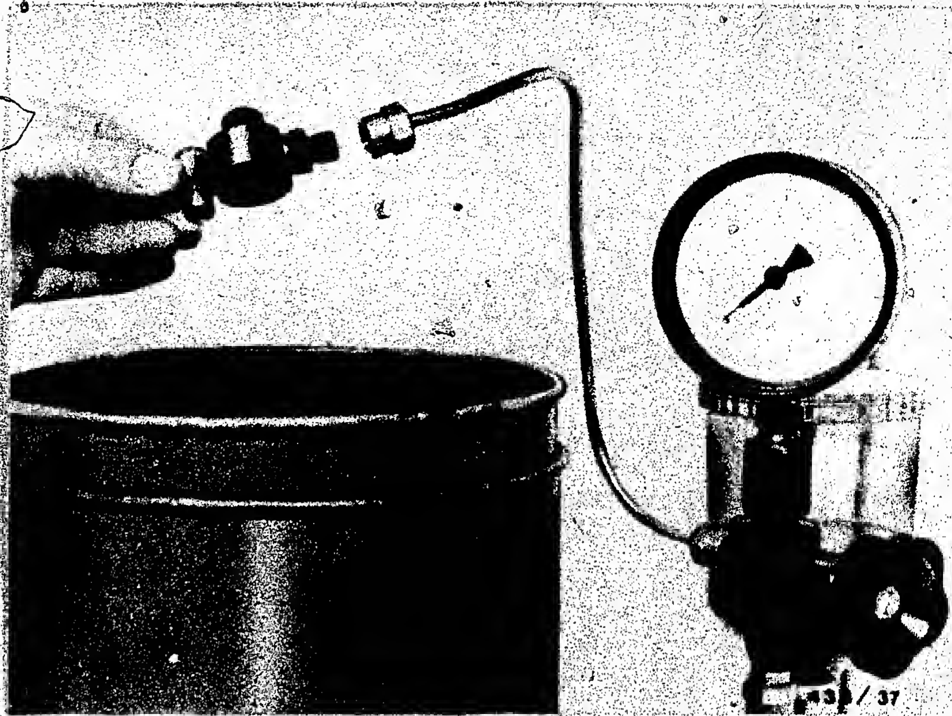
- Damaged or rough needle valve seat
- A pintle that is broken off or damaged
- Coked transverse or longitudinal hole in the pintle (hole-type pintle nozzle)

Examine the nozzle body with the illuminating magnifying glass 0 681 104 000 for pounding in or coking at the seat. The spray hole must be round and likewise must not be coked.

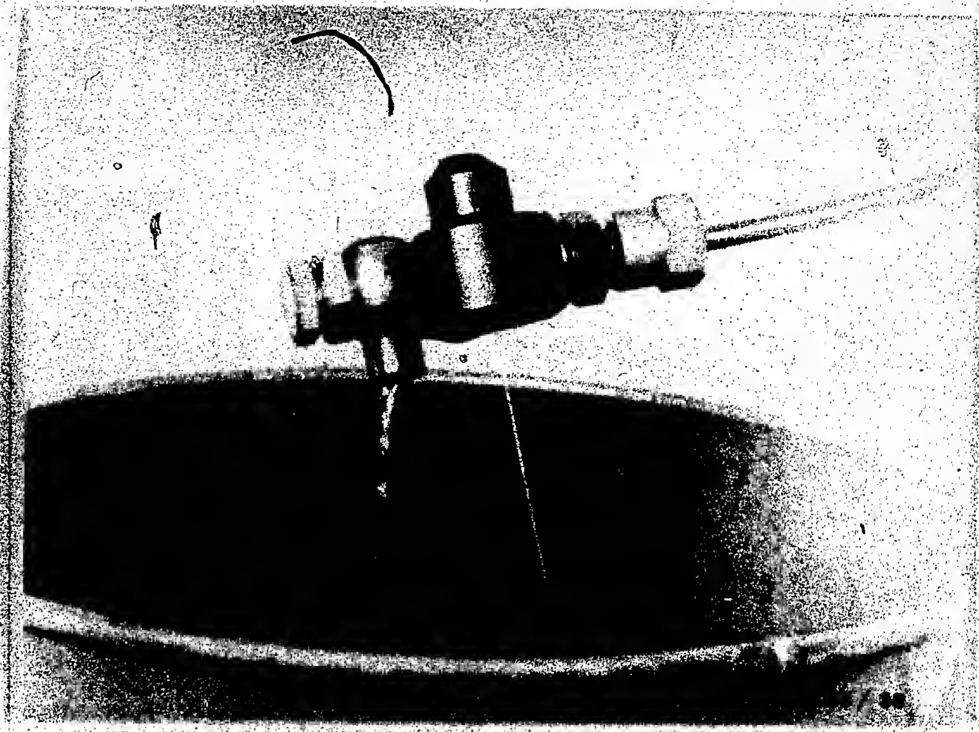


6.3 Checking the transverse and longitudinal holes in the pintle of the needle valve on hole-type pintle nozzles

Insert the the needle valve in the needle valve tester 1 688 130 153 and finger-tighten the retaining nut.



Connect needle valve tester 1 688 130 153 to the nozzle tester 0 681 200 502.
By moving the pump lever, increase the pressure until test oil comes out at the overflow valve on the needle valve tester.



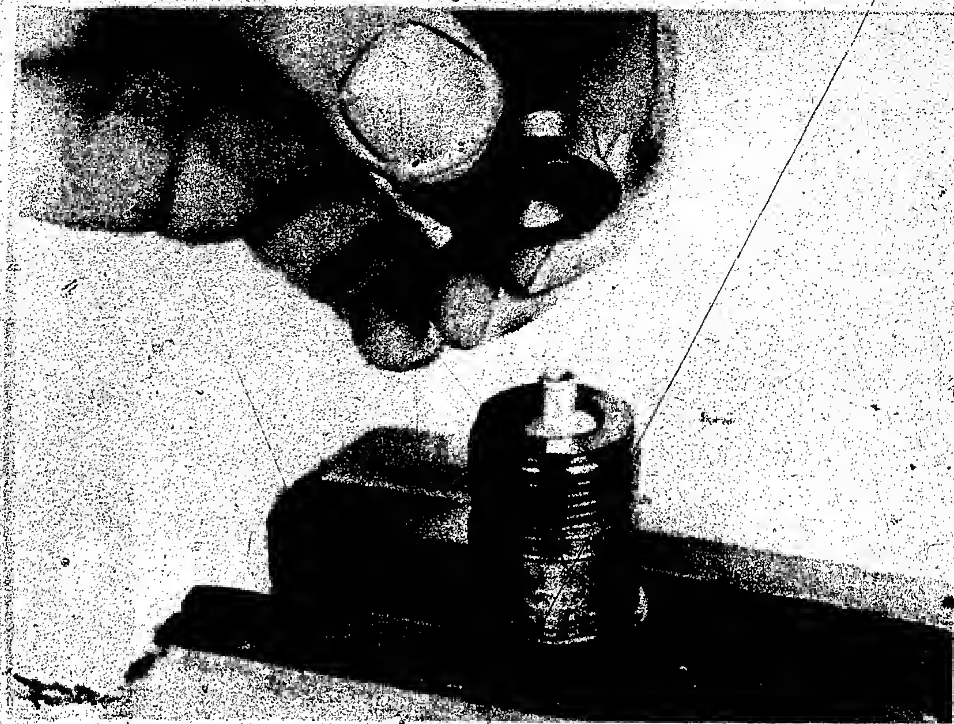
With continued uniform, slow movement of the lever (4...6 seconds for one downward movement of the hand lever), a fine, clear, axial cord spray must come out of the longitudinal hole in the needle valve pintle. If no cord spray is visible, the longitudinal hole must be cleaned using the appropriate cleaning needle in the nozzle cleaning kit, or the complete nozzle must be taken out and replaced.

Unscrew the retaining nut from the needle valve tester. Remove the needle valve from the tester and insert it into its nozzle body.

Caution!
The needle valve and the nozzle body are paired to one another. For that reason, a needle valve must always be inserted into its own nozzle body!

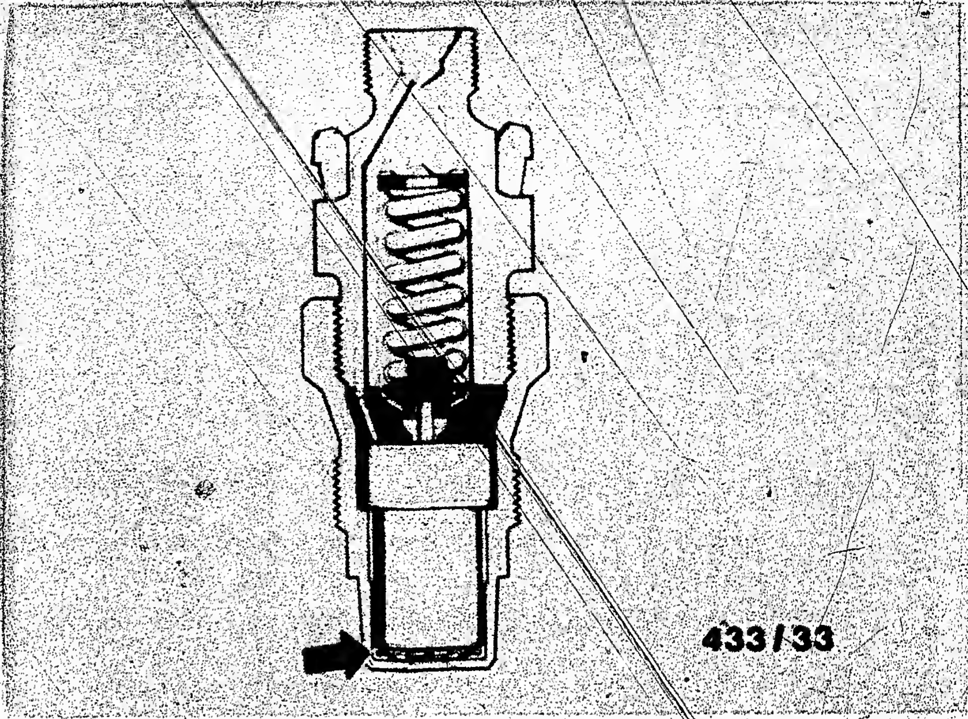
6.4 Sliding test

Run the sliding test after visual inspection of all nozzles (new or used).
First dip the needle valve into clean test oil or diesel fuel, and insert it into the nozzle body. Then, holding the nozzle body in an approximately vertical position, pull the valve by hand up to one-third of the way out of the nozzle body. When it is released, it must slide back to its seat due to its own weight.

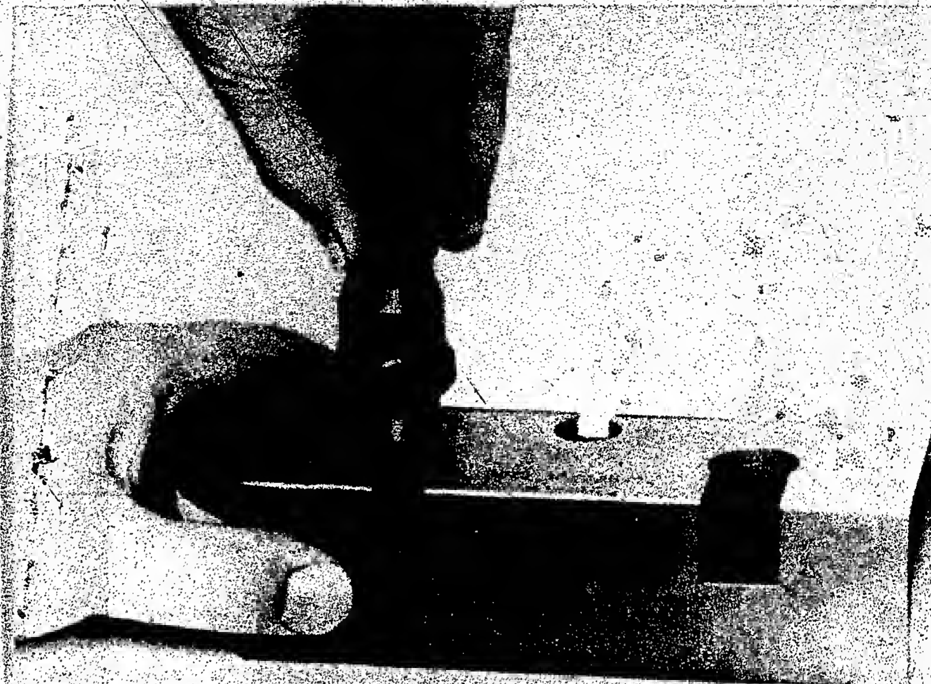


6.5 Assembling the nozzle-and-holder assembly

Install all parts of the nozzle-holder-assembly as called for in the service parts list into the nozzle body. Set the nozzle on the clean seal surface of the intermediate disc.
In the case of nozzle-holder assemblies with adapter pins, align the nozzle in such a way that the adapter pin of the holder can be introduced properly into the adapter pin holes on the nozzle.

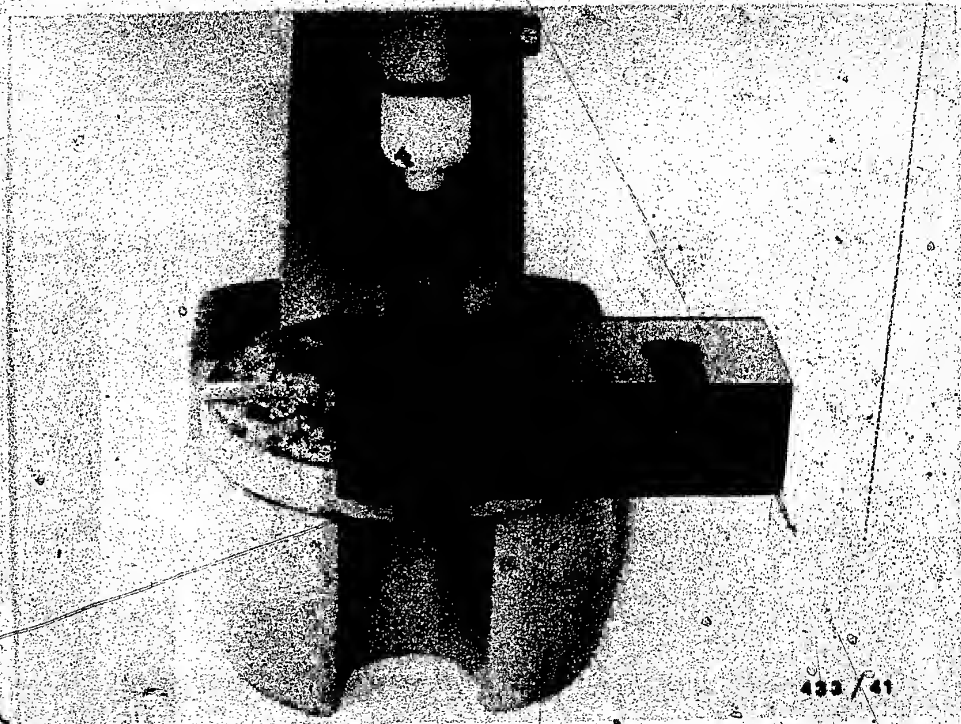


In the case of nozzle-holder assemblies with a thermal protection disc provided in the nozzle retaining nut (see the Figure, arrow), do not put this disc in yet. Because it may be used only once, it is not inserted into the nozzle retaining nut until after completing the adjustment of pressure.

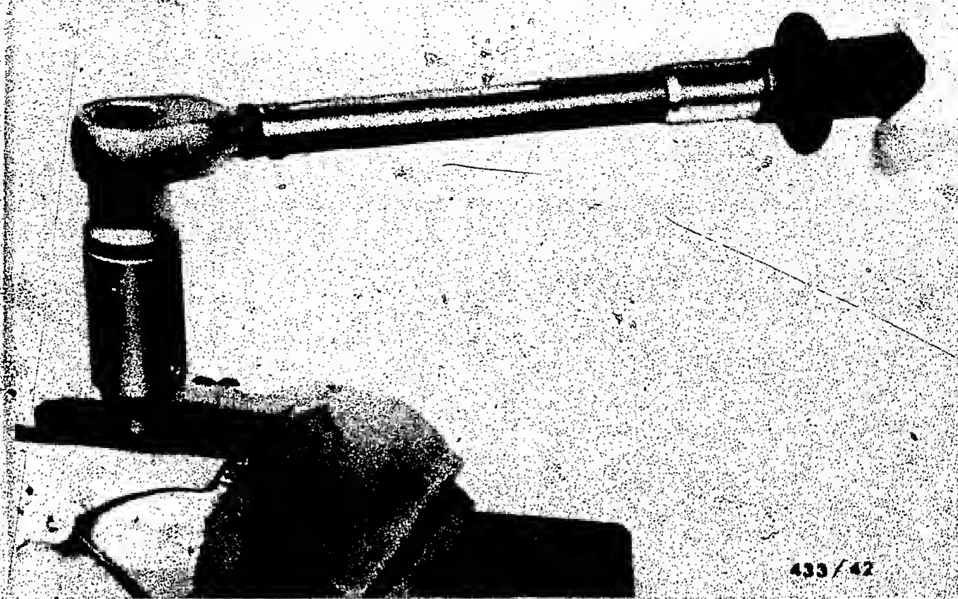


433/40-1

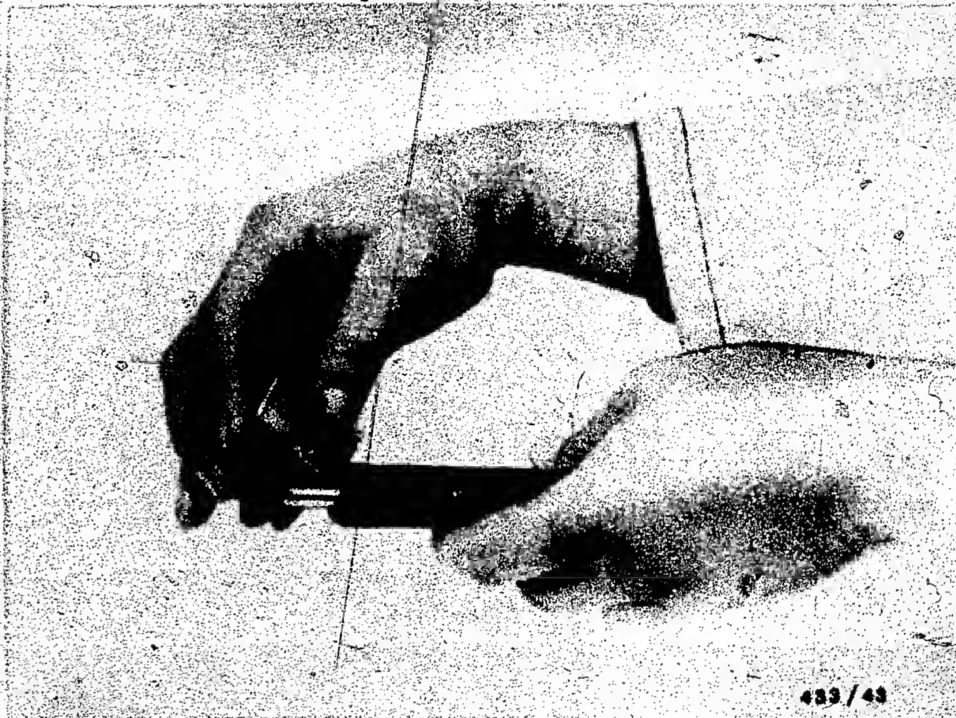
Screw the nozzle retaining nut onto the supporting device. Before it touches the nozzle when being screwed tight, the complete nozzle-and-holder assembly is inserted into the recess provided for it on the support plate KDEP 1043/0/1. (See the Figure.)



Insert the fitting pressure piece on the mounting device KDEP 1043 into the drill chuck of the drill press or the plunger receptacle on the hand-operated press.
Position the support plate with the nozzle-and-holder assembly on it under the pressure piece in such a way that the pressure piece presses on the portion of the nozzle furthest forward (see Figure).
By pressing on the nozzle, relieve the retaining nut, and screw it as far as possible onto the supporting device.



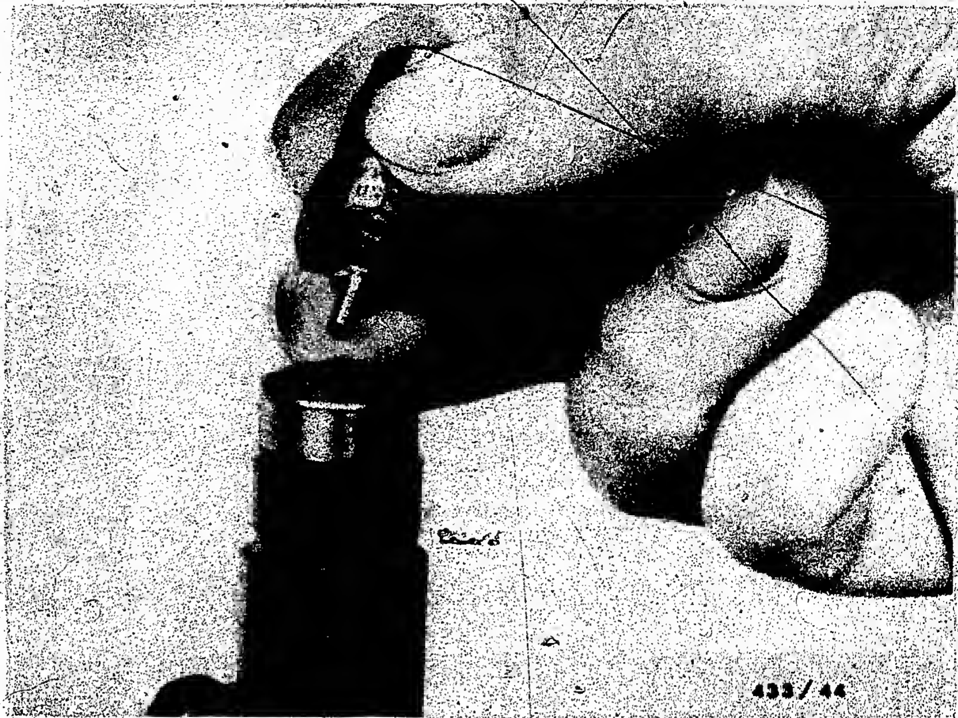
Then remove the complete nozzle-and-holder assembly from the support plate and clamp it into the vise. (Use protective jaws!) Using a socket wrench and a torque wrench, tighten the nozzle retaining nut to the prescribed tightening torque of 70...90 Nm.



433/43

7. Dismantling type KB..-, KD..-, and KE nozzle-and-holder assemblies

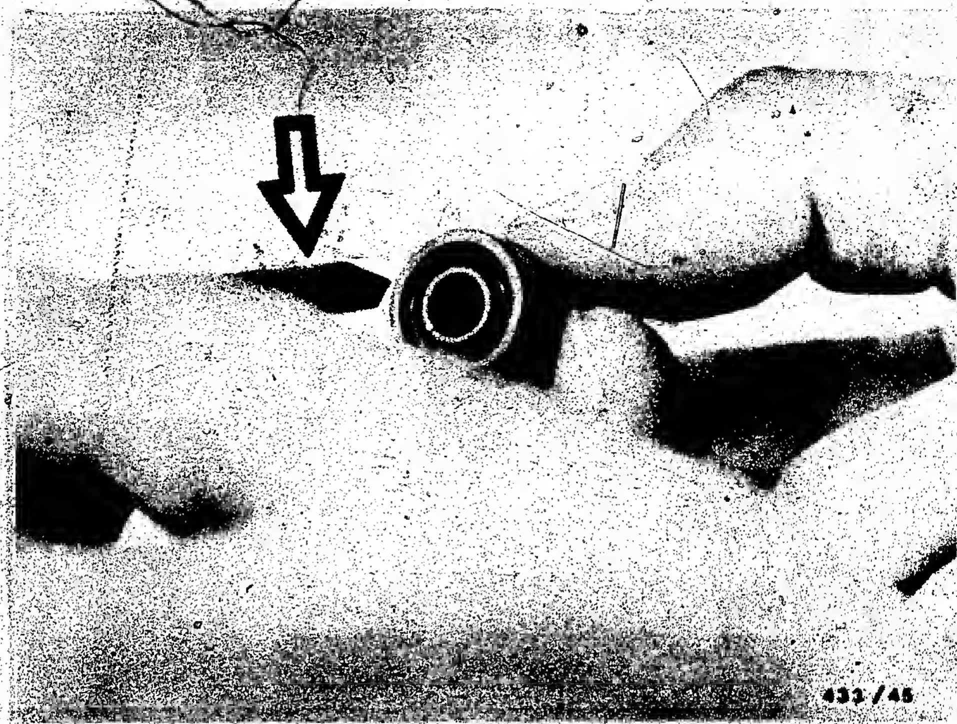
Take the complete nozzle-and-holder assembly out of the engine, and check it before dismantling. If need be, lay it in a cold cleaning solution, and clean the outside using the parts of the nozzle cleaning kit KDEP 2900 provided for that purpose.



Clamp the complete nozzle-and-holder assembly in the vise (using protective jaws!) so that the nozzle points up. (See the Figure.)

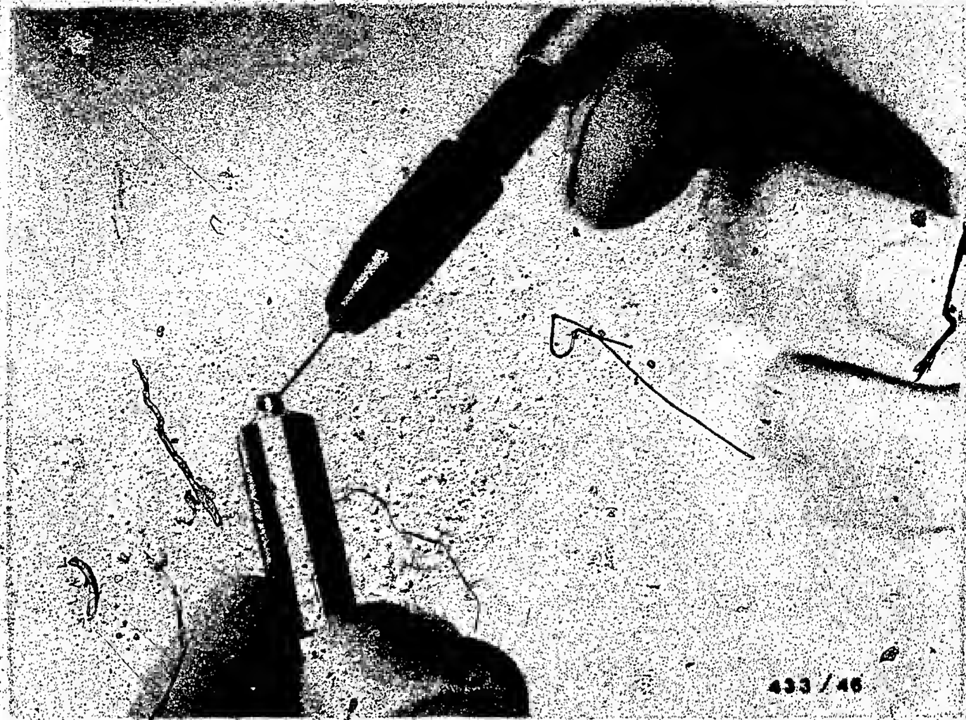
Release the nozzle retaining nut and unscrew it.

Take the nozzle, the intermediate disc, the thrust pin, the pressure spring, and the shim plate out of the holder and lay them to one side. (Do not damage the seal surface.)



7.1 Cleaning

When the nozzle-holder assembly has been taken apart, clean the parts with a cold cleaning solution. Clean new nozzles in diesel fuel or test oil per ISO 4113. Clean residues of dirt and combustion from used nozzles using the nozzle cleaning kit KDEP 2900. (See the Figure, arrow.) Then wash them out in a cold cleaning solution.

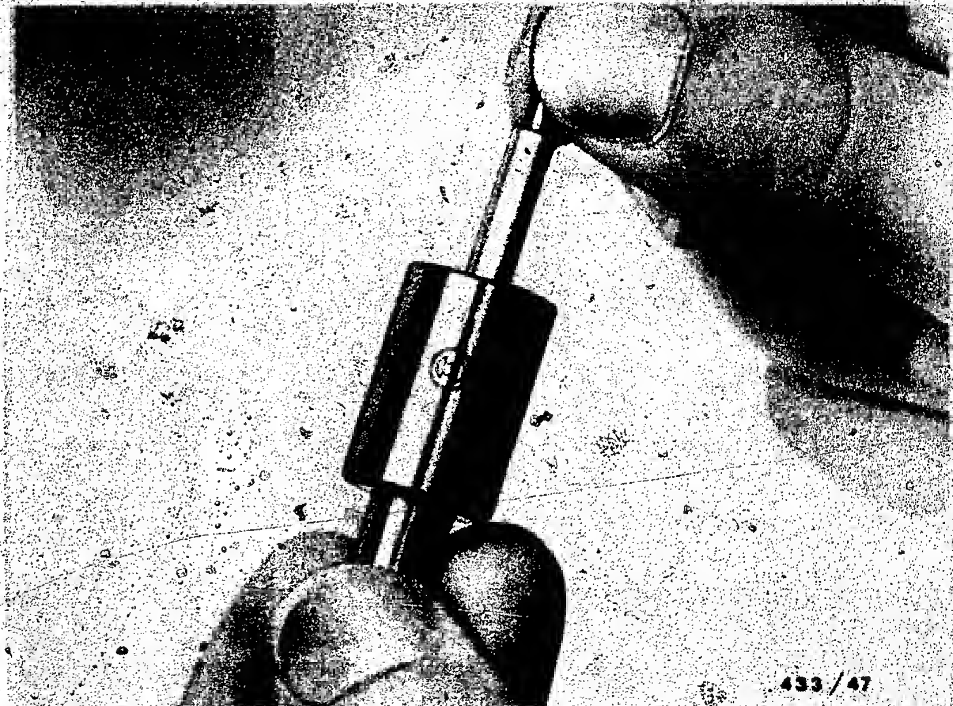


Clean the needle-valve seat and the pressure chamber of the nozzle body with toothpicks in diesel fuel. It is not permissible under any circumstances to use emery cloth, scrapers, or the like. Clean spray holes with appropriate cleaning needles of the nozzle cleaning kit KDEP 2900.

Then dip the needle valve into clean test oil or diesel fuel and insert it into the nozzle body.

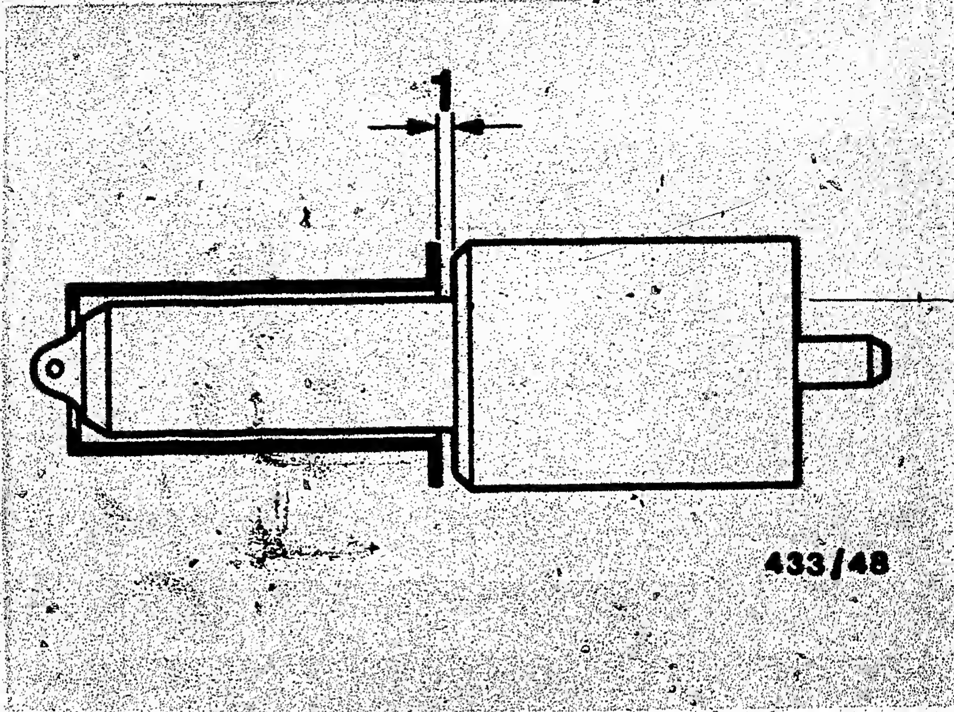
7.2 Visual inspection - hole-type nozzles

After cleaning, subject used nozzles to a visual inspection.
If the needle valve seat has damage or rough spots, take out and replace the complete nozzle. Using illuminating magnifying glass 0 681 104 000, examine the nozzle body for pounding in or coking at the seat. Likewise examine spray holes for coking or other clogging.


433/47

7.3 Sliding test

Run the sliding test after visual inspection of all nozzles (new or used).
First dip the needle valve into clean test oil or diesel fuel, and insert it into the nozzle body.
Then, holding the nozzle body in an approximately vertical position, pull the valve by hand up to one-third of the way out of the nozzle body. When it is released, it must slide back to its seat due to its own weight.

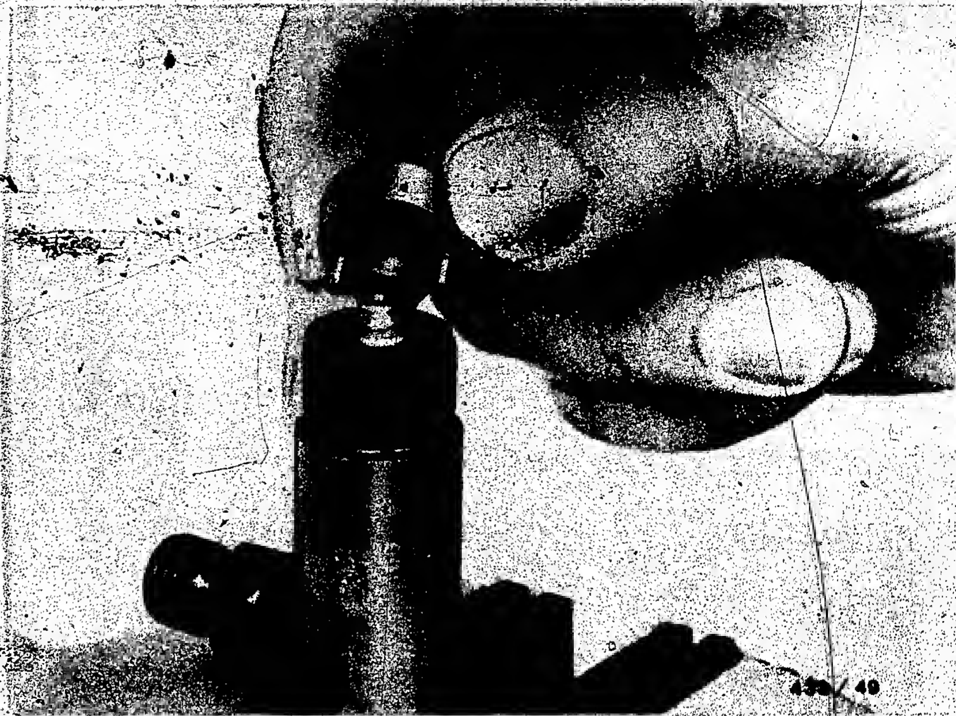


1 = Gap 0.1...0.55 mm

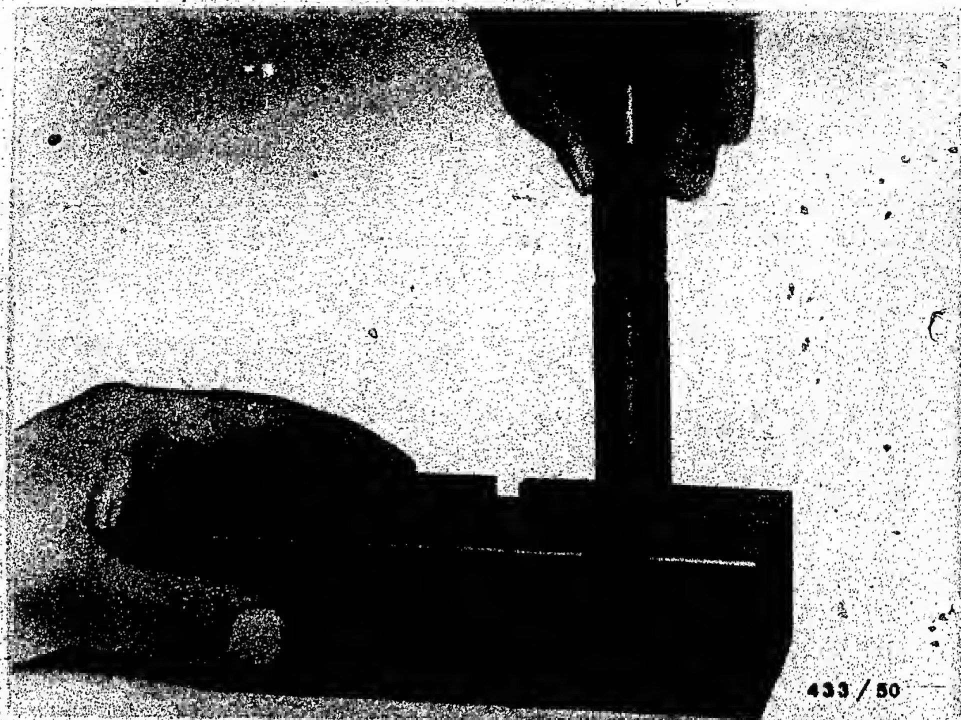
7.4 Assembling the nozzle-and-holder assembly

Instructions for nozzle-and-holder assemblies with a thermal protection sleeve

Take out and replace the thermal protection sleeves every time the nozzle-and-holder assembly is taken apart. The gap between the thermal protection sleeve and the nozzle body must be from 0.1...0.55 mm. To be checked before assembly.

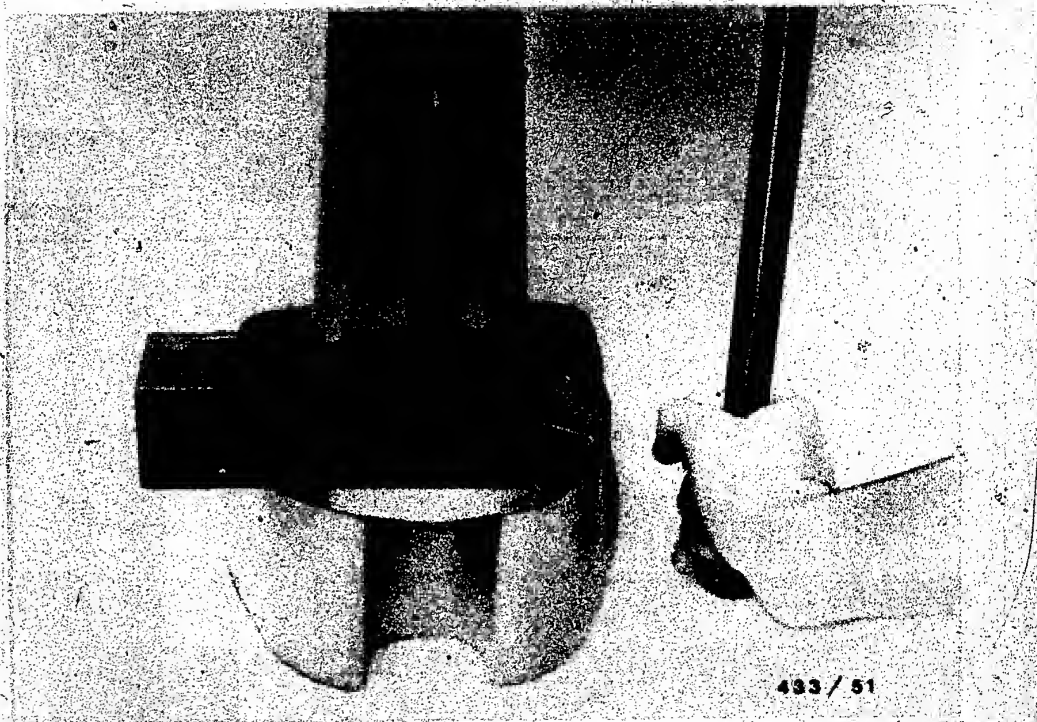


Install all parts of the nozzle-holder assembly as called for in the service parts list into the nozzle-holder body.
Set the nozzle on the clean seal surface of the intermediate disc.
For nozzle-holder assemblies with adapter pins, align the nozzle in such a way that the adapter pins of the holder are introduced properly into the adapter pin holes of the nozzle.

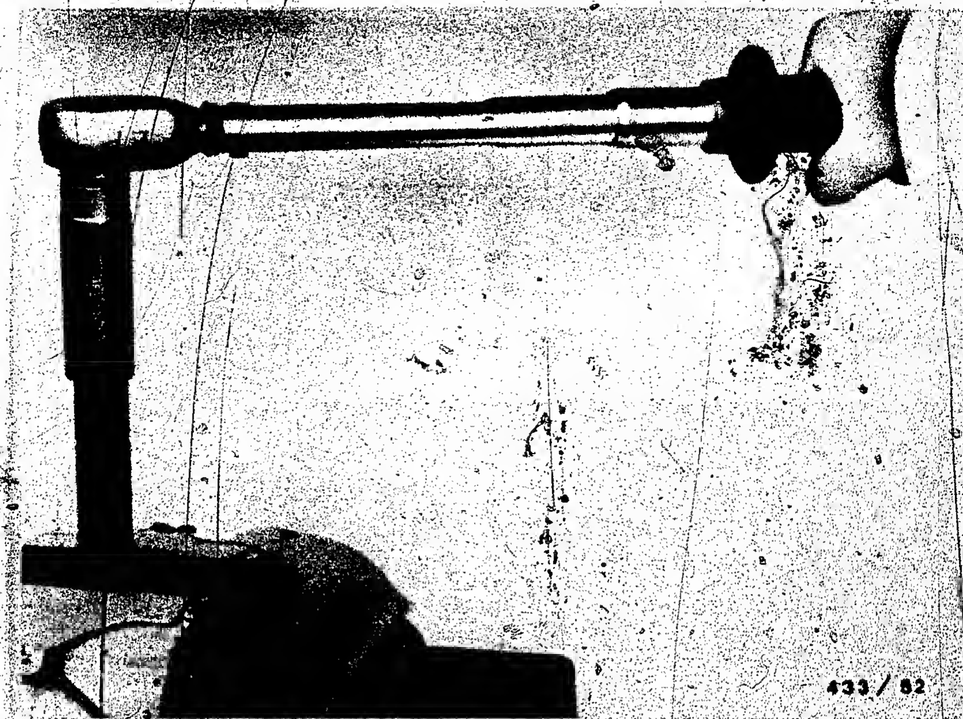


433 / 50

Screw the nozzle retaining nut onto the supporting device. Before it touches the nozzle when being screwed tight, the complete nozzle-and-holder assembly is inserted into the recess provided for it on the support plate KDEP 1043/0/1.



Insert the fitting pressure piece on the mounting device KDEP 1043 into the drill chuck of the drill press or the plunger receptacle on the hand-operated press.
Position the support plate with the nozzle-and-holder assembly on it under the pressure piece in such a way that the pressure piece presses on the portion of the nozzle furthest forward. By pressing on the nozzle, relieve the retaining nut, and screw it as far as possible onto the supporting device.



Then remove the complete nozzle-and-holder assembly from the support plate and clamp it into the vise. (Use protective jaws!) Using a socket wrench and a torque wrench, tighten the nozzle retaining nut to the prescribed tightening torque.

Tightening torques for assembly

Screwed connection	Type of		
	KBAL(Z)..P.. Nm	KDAL(Z)..P.. Nm	KBEL(Z)..P.. Nm
Nozzle retaining nut	30...40	30...40	40...50
Inlet connector in holder body	-	-	30...45
Tube fitting for leakage connection	-	-	-

Screwed connection	Type of		
	KBAL(Z)..S.. Nm	KDAL(Z)..S.. Nm	KB..TA.. Nm
Nozzle retaining nut	70...90	70...90	100...140
Inlet connector in holder body	45...65*	45...65*	90...110**
Tube fitting for leakage connection	-	-	-

*) For nozzle-holder assemblies with a through stem (without a pre
side, the tightening torque is 30...45 Nm.

**) For inlet connectors with connecting thread M22x1.5, the tighte

nozzle-holder assembly			
KDEL(Z)..P.. Nm	KBEL(Z)..S.. Nm	KDEL(Z)..S.. Nm	KB(L)..S.. Nm
40...50	50...70	50...70	70...90
30...45	30...45	30...45	45...65
-	-	-	-

nozzle-holder assembly		
KBF..T.. Nm	KB..U.. Nm	KBF..U.. Nm
100...140	200...220	200...220
90...110**	120...140	120...140
-	50...60	-

ssed-on head) and with inlet connectors screwed on at the

ning torque is 120...140 Nm.

8. Testing with nozzle tester

8.1 Testing pintle nozzles

Throttling pintle nozzles, pierced (hole-type) pintle nozzles, and flat-type pintle nozzles
Test criteria:

- Opening pressure
- Leakage
- Chatter behavior
- Spray pattern
- Preliminary spray of the hole-type pintle nozzle

For testing, use only clean test oil per ISO 4113 or clean diesel fuel.

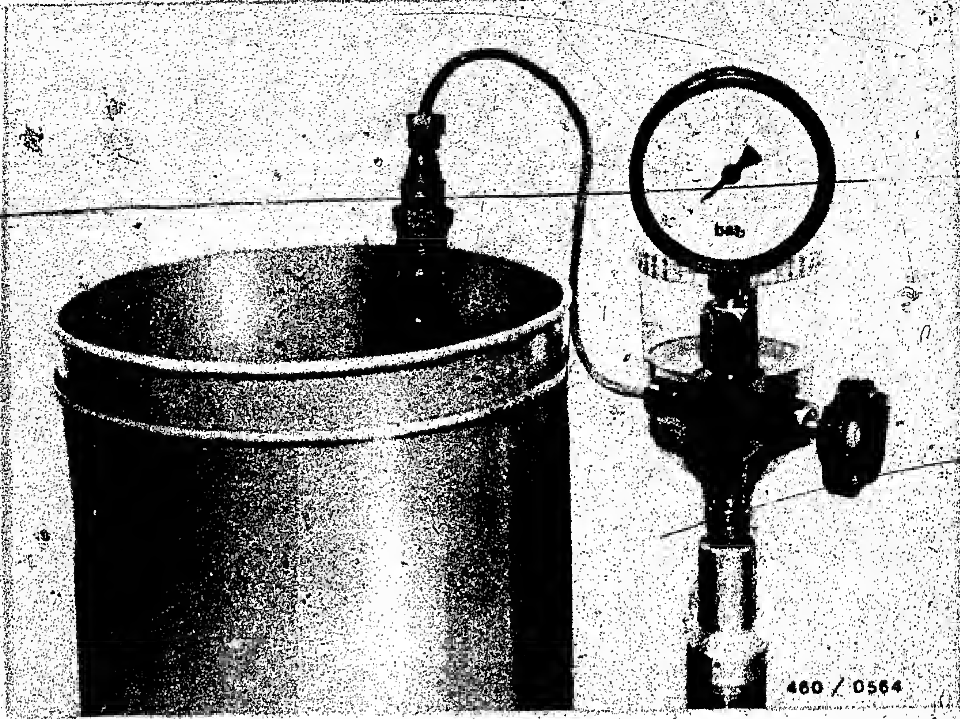
Test nozzles with appropriate nozzle-holder assemblies.

If nozzles are supplied for testing without the nozzle-holder assemblies that belong with them, the following nozzle-holders or quick-clamping devices can be used:

Nozzle Size	Nozzle Holder Part No.	Quick-Clamping Device * Part No.
R	0 431 101 010	0 681 243 006
S	0 681 243 005	0 681 243 003
T	0 681 343 002	0 681 243 004

* There must always be a damping spring installed in the quick-clamping device.

Nozzles of type DNA must always be tested together with the nozzle-holder assembly that goes with them, because these nozzles have only one inlet hole without a ring slot. (Nozzle-holder assemblies with a locking pin.)



Connect the nozzle-and-holder assembly and the appropriate delivery line to nozzle tester 0 681 200 502 (EFEP 60 H). To guarantee that a nozzle is not incorrectly gripped, push several times strongly on the hand lever for the nozzle tester with the pressure gauge switched off (approx. 4 to 6 downward movements per second).

When working on the nozzle tester, follow the safety regulations below:

1. Keep your hands away from the nozzle jet!

The jet from a nozzle penetrates deeply into the flesh of the finger or the hand, and destroys the tissue. The test oil penetrating into the blood can cause blood poisoning.

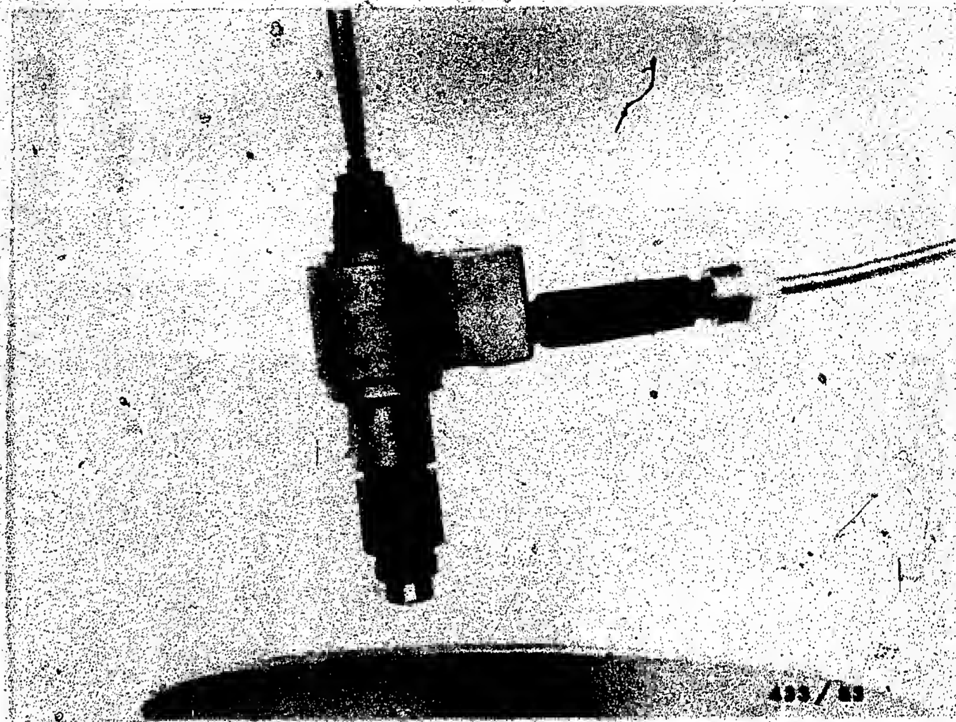
8.1.1 Checking opening pressure

Open the shutoff valve on the pressure gauge by approx. 1/4 turn.
Slowly press down on the hand lever of the nozzle tester. The pressure shown on the pressure gauge then rises. Observe the pressure at which the needle of the pressure gauge stops (without the nozzle chattering), or when the pressure drops off suddenly (the nozzle chatters). The maximum pressure attained is the opening pressure.
The opening pressure provided for a nozzle-and-holder assembly is stamped in in some cases on the nozzle-holder body.
If that is not the case, the value must be obtained from the corresponding documents from the manufacturer of the engine or from the microfiche cards on equipment (A...). The tolerance for settings is generally + 8 bar.

The following values apply for the DDAD (GMC/ Chevrolet) - nozzle-and-holder assemblies 0 432 217 081, 0 432 217 092, and 0 432 217 104:

For rechecking: min. 105 bar

For new setting: 125 + 10 bar



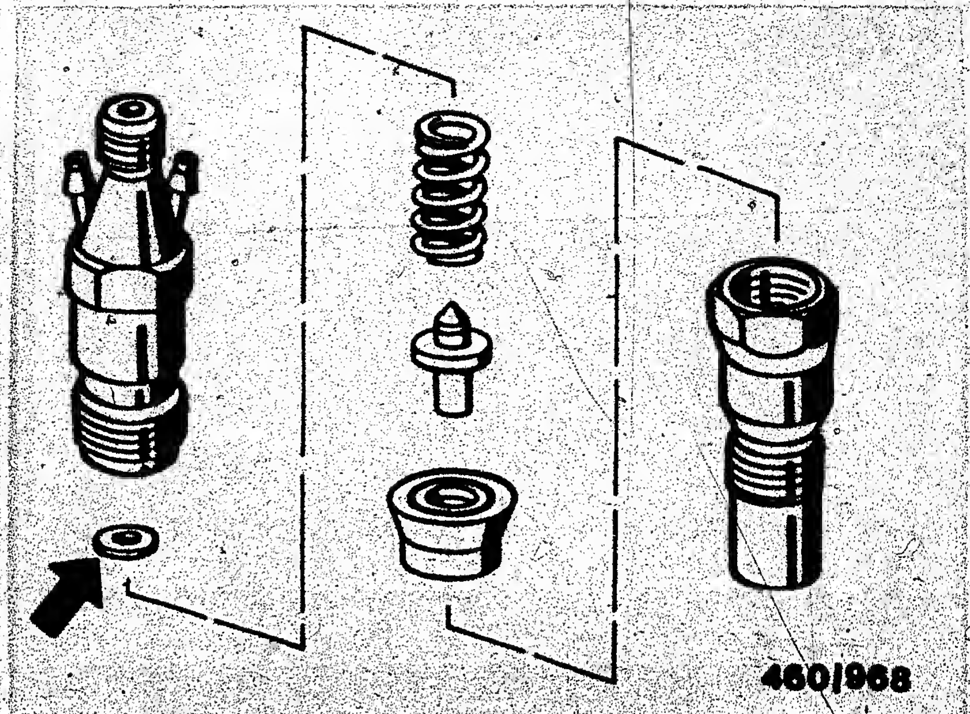
8.1.2 Setting the opening pressure (KB(L)..S.., KB(F)..T.., KB(F)..U..)

Unscrew the closure cap. Release the lock nut and turn the setting screw until the prescribed opening pressure has been attained. Turning the screw further in raises the opening pressure. Once the opening pressure has been attained, tighten the locking nut to the prescribed torque and screw the closure cap back on.

8.1.3 Tightening torques

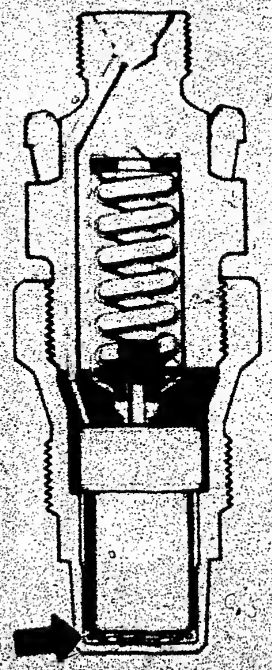
Screwed connection	Type of nozzle-holder assembly		
	KB(L)..S.. Nm	KB..TA.. Nm	KBF..T.. Nm
Locking nut (for setting screw)	5...15	10...20	5...10
Cap nut (closure cap)	40...60	40...60	40...60

Screwed connection	Type of nozzle-holder assembly	
	KB...U.. Nm	KBF...U.. Nm
Locking nut (for setting screw)	30...40	10...20
Cap nut (closure cap)	50...70	50...70



8.1.4 Setting opening pressure (KCA..S)

Unscrew the complete nozzle-and-holder assembly from the delivery line of the nozzle tester and clamp it into the vise. Use protective jaws!
Unscrew the nozzle retaining nut, take off the nozzle and lay it to one side. Remove all other parts of the nozzle-holder assembly. The opening pressure is set by selecting the adjusting shim required. (See the Figure, arrow.) A thicker shim raises the opening pressure. Then reassemble the nozzle-and-holder assembly as described and test on the nozzle tester.



433/33

Once the prescribed opening pressure has been attained, for nozzle-and-holder assemblies with built-in thermal protection, install a new thermal-protection disc in the proper position in the nozzle retaining nut. (See the Figure, arrow.)

8.1.5 Test for leaks

The shutoff valve on the pressure gauge of the nozzle tester remains open by approx. 1/4 turn.
To make a reliable evaluation of leakage possible, dry off the bottom portion of the nozzle and the nozzle-holder assembly. (Blow it dry with air.)
Slowly press down on the hand lever of the nozzle tester until the pressure gauge indicates 20 bar less than the opening pressure as read previously. The nozzle does not leak if there is no drop dripping at the opening of the nozzle within 10 seconds.

If however a drop drips off, take the nozzle-and-holder assembly apart again, clean the parts of the nozzle holder and the nozzle, and thus eliminate the leak.
If the nozzle is leaking again when the test is repeated, replace it with a new nozzle. It is not permissible to remachine parts of the nozzle.

For nozzle-and-holder assemblies with a built-in thermal protection, take out and replace the pertinent thermal protection disc between the nozzle and the nozzle retaining nut every time the assembly is taken apart.

8.1.6. Chatter test, evaluation of the spray pattern

General information:
When evaluating the nozzles, distinguish between new and used nozzles.
Run the chatter test and the spray test one after the other!
Switch the pressure gauge of the nozzle tester off by closing the shutoff valve.
That is necessary to protect the pressure gauge.

New nozzles:
The chatter test makes it possible to test by listening for the ease of movement of the needle valve inside the nozzle body. If a nozzle does not chatter in spite of cleaning, it is to be taken out and replaced with a new nozzle. In the chatter test, the shape of the spray is of no significance. A spray pattern conforming to specifications is generally present only with new nozzles.

Used nozzles:
The chatter behavior of the nozzle deteriorates due to wear in the seat region. When the lever is moved quickly, the nozzle must chatter audibly and/or spray with good atomization. On used nozzles, the spray pattern can deviate from the ideal shape for a new nozzle. It is not possible in every case to conclude that there will be a negative effect on the operation of the engine from this.
However, the spray pattern of such nozzles can be improved perceptibly by means of appropriate cleaning actions.

Pintle nozzles without throttling (new nozzles) DN..R.., DN..S.., DN..T..

Chatter test:

These pintle nozzles chatter quite audibly across the entire range of lever speed that can be attained. Minimum testing speed: 1 downward movement of the hand lever per second.
The occurrence of small interim ranges without chatter is of no significance. The shape of the spray is likewise of no significance during the chatter test.

Spray pattern:

A well-atomized even spray regardless of the speed of testing. (Watch the spray angle.)

Throttling pintle nozzles, including pierced (hole-type) pintle nozzles, not including flat-type pintle nozzles; and not including the model for DDAD (GMC-Chevrolet) DN 0 SD 248 - 0 434 250 105 or DN 0 SD 253 - 0 434 250 111

DN..RD.., DN..SD.., DN..TD..

Chatter test:

Due to its special structural features, this nozzle chatters very softly. With it, a chatter test is possible only when the hand lever is moved downward between 1...2 times per second.
If the testing speed is increased, the chatter stops. The test oil then comes out of the nozzle with a hissing sound. Only when the hand lever is moved suddenly and quickly (approx. 4...6 downward movements per second) does the nozzle chatter with a high-pitched tone.

Spray pattern: (applies only to new nozzles)

It is possible to evaluate the shape of the spray only if the hand lever is moved quickly. (4...6 downward movements per second.) The spray must be compact and well atomized.

Throttling pintle nozzle, model for DDAD (GMC/Chevrolet) DN 0 SD 248 - 0 434 250 105 or DN 0 SD 253 - 0 434 250 111 in nozzle-and-holder assemblies 0 432 217 081, 0 432 217 092 and 0 432 217 104

Chatter test:

Due to the special structural features, run the chatter test as follows:
Slowly press down on the hand lever of the nozzle tester and find out whether chattering sounds can be heard. If no chatter is audible, keep moving the hand lever faster until the nozzle chatters.
If the nozzle cannot be brought to chatter, first unscrew the nozzle retaining nut, clean the seat surface for the nozzle's thermal protection disc and the nozzle retaining nut well, and, using a new thermal protection disc, put the retaining nut back on. If there is still no chattering attained, take out and replace the nozzle.

Spray test: (applies only to new nozzles)

Quickly press the hand lever on the nozzle tester downward suddenly. The fuel spray must be compact and well atomized.

Throttling pintle nozzle - flat-type pintle nozzle - DN...SD..

These nozzles have a flat ground at the side of the pintle. The flat surface thus made produces an oval shape in the spray.

Chatter test:
Due to its special structural features, this nozzle chatters very softly. With it, a chatter test is possible only when the hand lever is moved downward between 1...2 times per second. If the testing speed is increased, the chatter stops. The test oil then comes out of the nozzle with a hissing sound. Only when the hand lever is moved suddenly and quickly (approx. 4...6 downward movements per second) does the nozzle chatter with a high-pitched whistling tone.

Spray pattern: (applies only to new nozzles)
Until the high-pitched whistling tone is reached, the spray can be in strands and can come out without atomization. A divided spray and the formation of streams are of no significance in this range. For evaluation of the spray shape, the hand lever is pressed down suddenly and quickly (4...6 downward movements per second). The spray must then be well atomized. The spray cross-section is oval in shape and is larger than the spray from a throttling pintle nozzle without the flat on the pintle.

Throttling pintle nozzle - Pintaux nozzles - DN...SD.., DNA..SD..

The base of these nozzles has a special shape and they have an additional spray cover through which the preliminary spray comes out.

Chatter test:
Due to its special structural features, this nozzle chatters very softly. With it, a chatter test is possible only when the hand lever is moved downward between 1...2 times per second. If the testing speed is increased, the chatter stops. The test oil then comes out of the nozzle with a hissing sound. Only when the hand lever is moved suddenly and quickly (approx. 4...6 downward movements per second) does the nozzle chatter with a high-pitched whistling tone.

Spray pattern: (applies only to new nozzles).
With a low testing speed, the majority of the delivery must exit through the preliminary spray hole at the side well-atomized and without heavy streaming. It is possible to evaluate the main spray only when the hand lever is moved quickly (approx. 4...6 downward movements per second). The spray must be compact and well atomized.

8.2 Testing hole-type nozzles

Test criteria:

- Opening pressure
- Leakage
- Chatter behavior
- Spray pattern

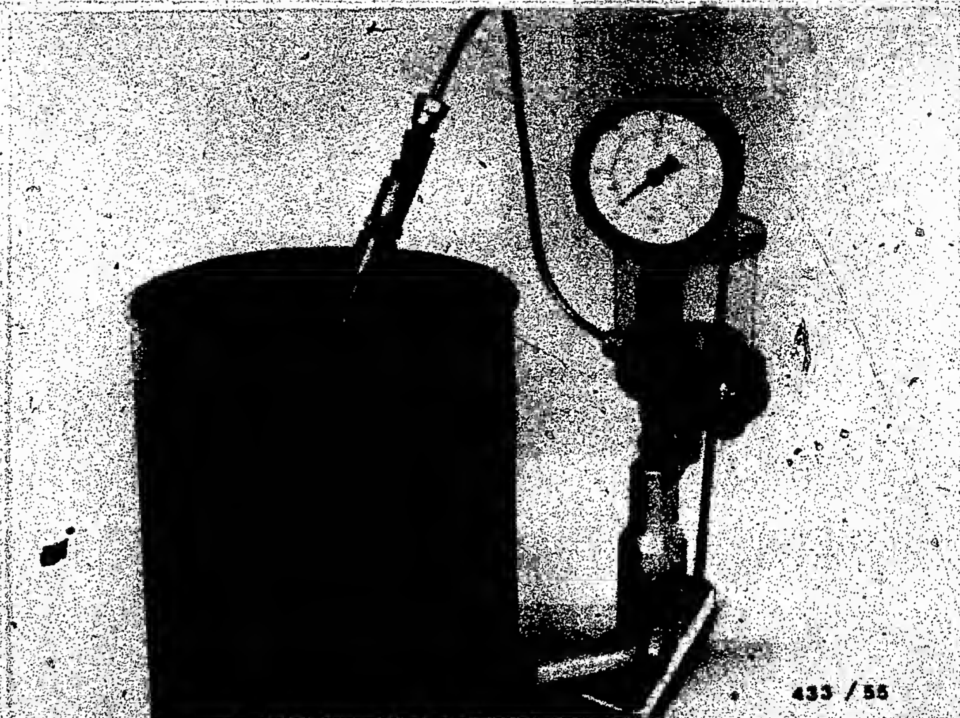
For testing, use clean test oil per ISO 4113 or clean diesel fuel.
Test the nozzles together with the nozzle-holder assemblies that go with them.

If nozzles are to be supplied for testing without the nozzle-holder assemblies that go with them, the following nozzle holders or quick-clamping devices can be used:

Nozzle Size	Nozzle Holder Part No.	Quick-Clamping Device *
P	----	----
S	0 681 243 005	0 681 243 003
T	0 681 343 002	0 681 243 004

* There must always be a damping spring put into the quick-clamping device.

Nozzles of type DLLA.. must always be tested with the nozzle-holder assembly that goes with them, because these nozzles have only one inlet hole without a ring slot. (Nozzle-holder assembly with locking pin.)



Connect the nozzle-and-holder assembly and the test pressure line that goes with it to the nozzle tester 0 681 200 502 (EFEP 60 H). In order to be certain that the nozzle is not incorrectly gripped, move the hand lever of the nozzle tester down suddenly several times forcefully with the pressure gauge switched off (approx. 4...6 downward movements per second).

When working on the nozzle tester, follow the safety regulations below:

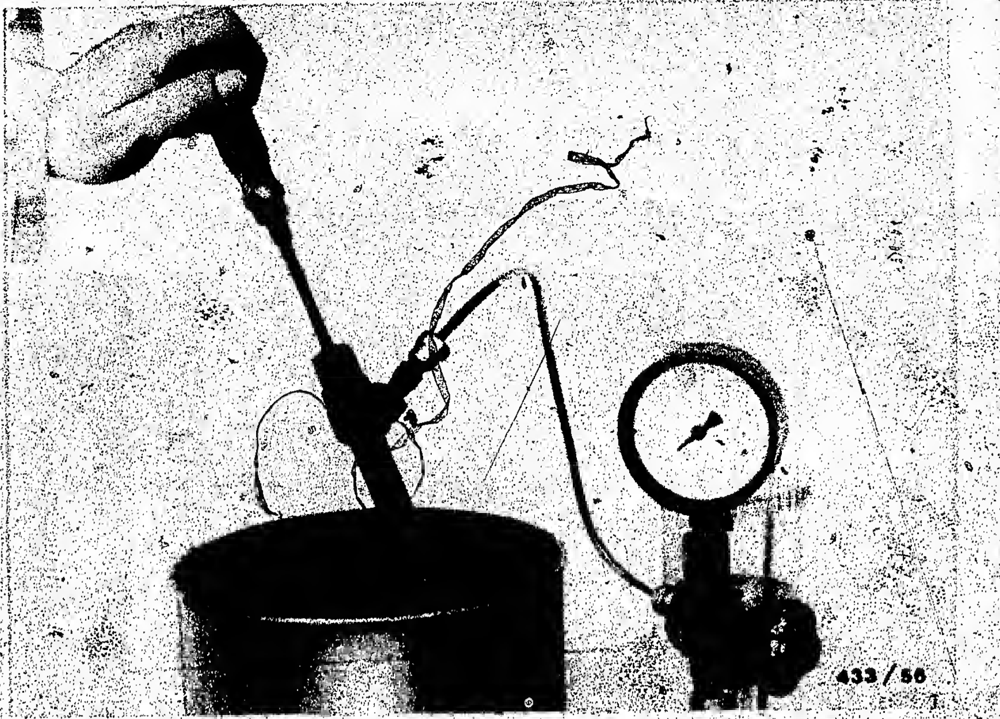
Keep your hands away from the nozzle jet!

The jet from a nozzle penetrates deeply into the flesh of the finger or the hand, and destroys the tissue. The test oil penetrating into the blood can cause blood poisoning.

8.2.1 Checking opening pressure

Open the shutoff valve on the pressure gauge by approx. 1/4 turn.
Slowly press down on the hand lever of the nozzle tester. The pressure shown on the pressure gauge then rises. Observe the pressure at which the needle of the pressure gauge stops (without the nozzle chattering), or when the pressure drops off suddenly (the nozzle chatters). The maximum pressure attained is the opening pressure.
The opening pressure provided for a nozzle-and-holder assembly is stamped in in some cases on the nozzle-holder body.
If that is not the case, the value must be obtained from the corresponding documents from the manufacturer of the engine or from the microfiche cards on equipment (A.+.). The tolerance for settings is generally + 8 bar.

M1



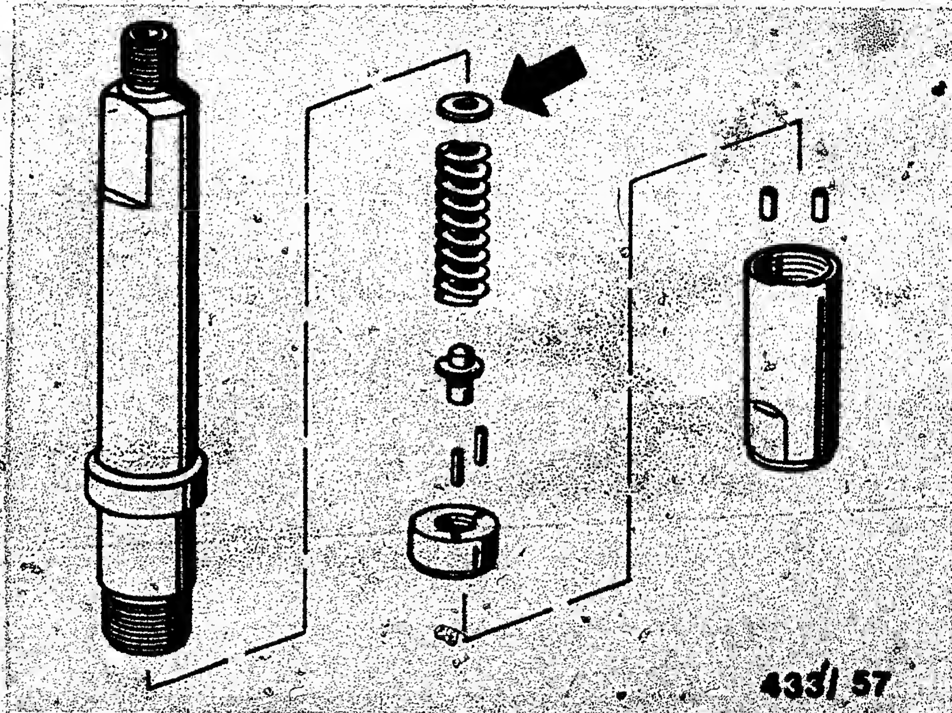
8.2.2 Adjusting opening pressure (KB(L)..S..,KB(F)..U..)

Unscrew the closure cap. Release the lock nut and turn the setting screw until the prescribed opening pressure has been attained. Turning the screw further in raises the opening pressure.
Once the opening pressure has been attained, tighten the locking nut to the prescribed torque and screw the closure cap back on.

8.2.3 Tightening torques

Screwed connection	Type of nozzle-holder assembly		
	KB(L)..S.. Nm	KB..TA.. Nm	KBF..T.. Nm
Locking nut (for setting screw)	5...15	10...20	5...10
Cap nut (closure cap)	40...60	40...60	40...60

Screwed connection	Type of nozzle-holder assembly		
	KB...U.. Nm	KBF...U.. Nm	
Locking nut (for setting screw)	30...40	10...20	
Cap nut (closure cap)	50...70	50...70	



8.2.4 Adjusting opening pressure (KDAL(Z)..,KDEL(Z)..)

Unscrew the complete nozzle-and-holder assembly from the delivery line of the nozzle tester and clamp it into the vise. Use protective jaws!
Unscrew the nozzle retaining nut, take off the nozzle and lay it to one side. Remove all other parts of the nozzle-holder assembly. The opening pressure is set by selecting the adjusting shim required. (See the Figure, arrow.) A thicker shim raises the opening pressure. Then reassemble the nozzle-and-holder assembly as described and test on the nozzle tester.

8.2.5 Test for leaks

The shutoff valve on the pressure gauge of the nozzle tester remains open by approx. 1/4 turn.
To make a reliable evaluation of leakage possible, dry off the bottom portion of the nozzle and the nozzle-holder assembly. (Blow it dry with air.)
Slowly press down on the hand lever of the nozzle tester until the pressure gauge indicates 20 bar less than the opening pressure as read previously. The nozzle does not leak if there is no drop dripping at the opening of the nozzle within 10 seconds.

If however a drop drips off, take the nozzle-and-holder assembly apart again, clean the parts of the nozzle holder and the nozzle, and thus eliminate the leak.
If the nozzle is leaking again when the test is repeated, replace it with a new nozzle. It is not permissible to remachine parts of the nozzle.

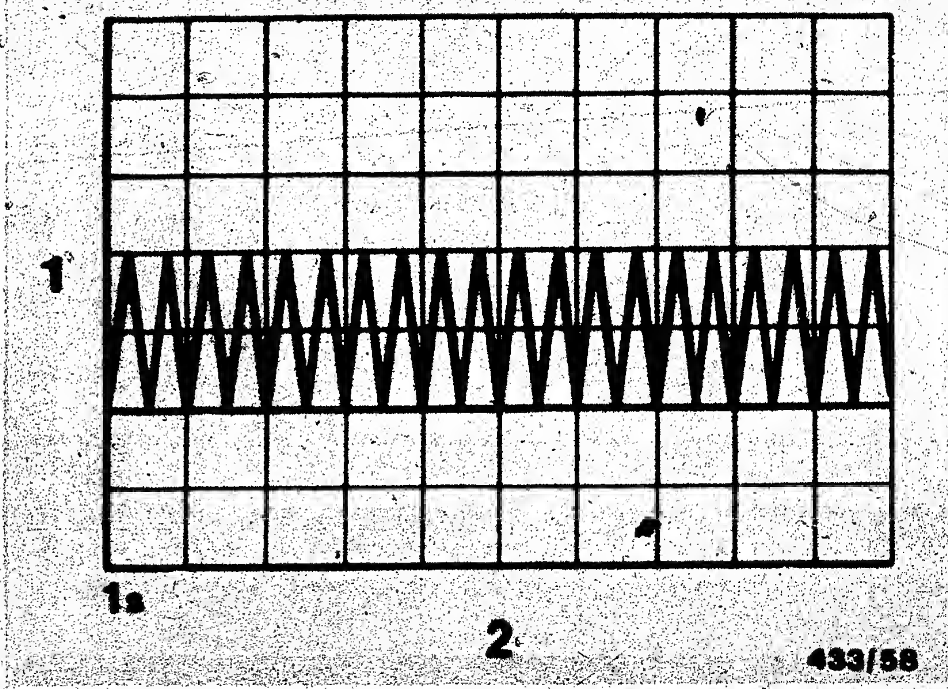
8.2.6 Chatter test and evaluation of the spray pattern

General information:
When evaluating the nozzles, distinguish between new and used nozzles.
Run the chatter test and the spray test one after the other!
Switch the pressure gauge of the nozzle tester off by closing the shutoff valve.
That is necessary to protect the pressure gauge.

New nozzles:
The chatter test makes it possible to test by listening for the ease of movement of the needle valve inside the nozzle body. The readiness with which new nozzles chatter depends upon the nozzle dimensions:
Diameters of seat, guide, and blind hole.
From these are derived groups of chatter characteristics that reproduce the chatter behavior of the nozzles. If a nozzle does not chatter in spite of cleaning, it is to be taken out and replaced with a new nozzle. In the chatter test, the shape of the spray is of no significance. A spray pattern conforming to specifications is generally present only with new nozzles.
Used nozzles:
The chatter behavior of the nozzle deteriorates due to wear in the seat region. For that reason, the groups of chatter characteristics are not to be applied here. The nozzle must chatter audibly when the lever is moved quickly (possibly with a high-pitched whistling tone), and it must spray with good atomization. In an individual case, a hole-type nozzle may still be usable if it chatters audibly (perhaps with a high-pitched whistling tone) or sprays with good atomization. On used nozzles, the spray pattern can deviate from the ideal shape for a new nozzle. It is not possible in every case to conclude that there will be a negative effect on the operation of the engine from this. However, the spray pattern of such nozzles can be improved perceptibly by means of appropriate cleaning actions.

The microfiche cards KP.. (Nozzle Characteristics) contain cross-reference to the group of chatter characteristics according to which the nozzle in question is to be tested.

The diagrams below are to show the movements of the needle valves, and how they chatter in the individual characteristic groups depending upon the speed with which the lever of the nozzle tester is moved.

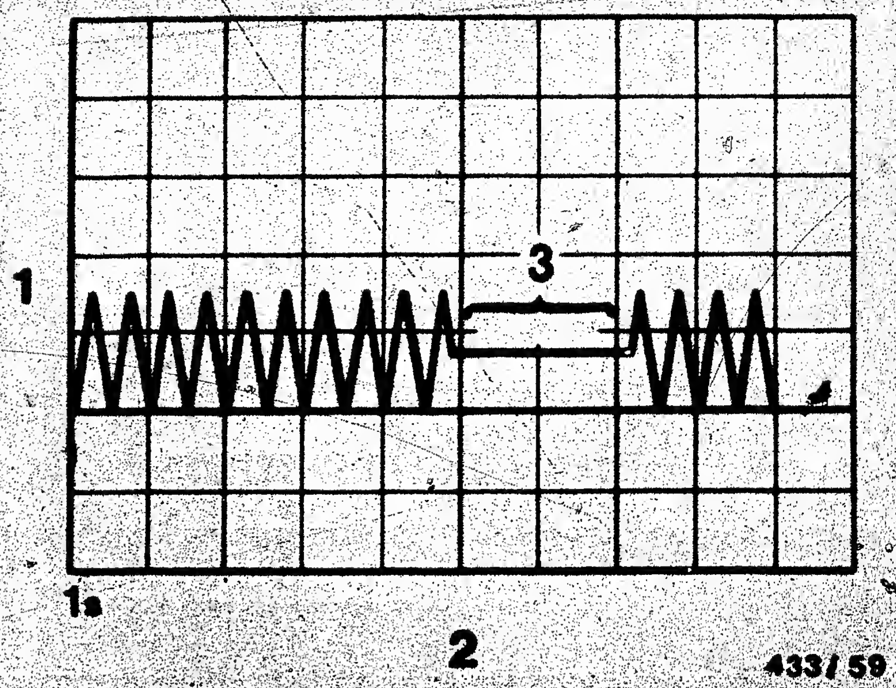


1 = Needle valve
2 = Time for 1 downward stroke movement of the hand lever (increasing testing speed)

Chatter characteristic group I

Chatter behavior:
Chattering well throughout the range of lever speeds that can be attained.
Minimum testing speed:
One downward movement per second.

Spray pattern:
At low testing speeds, broken spray patterns with coarse atomization.
As the lever speed is increased, the sprays become full and finely atomized.

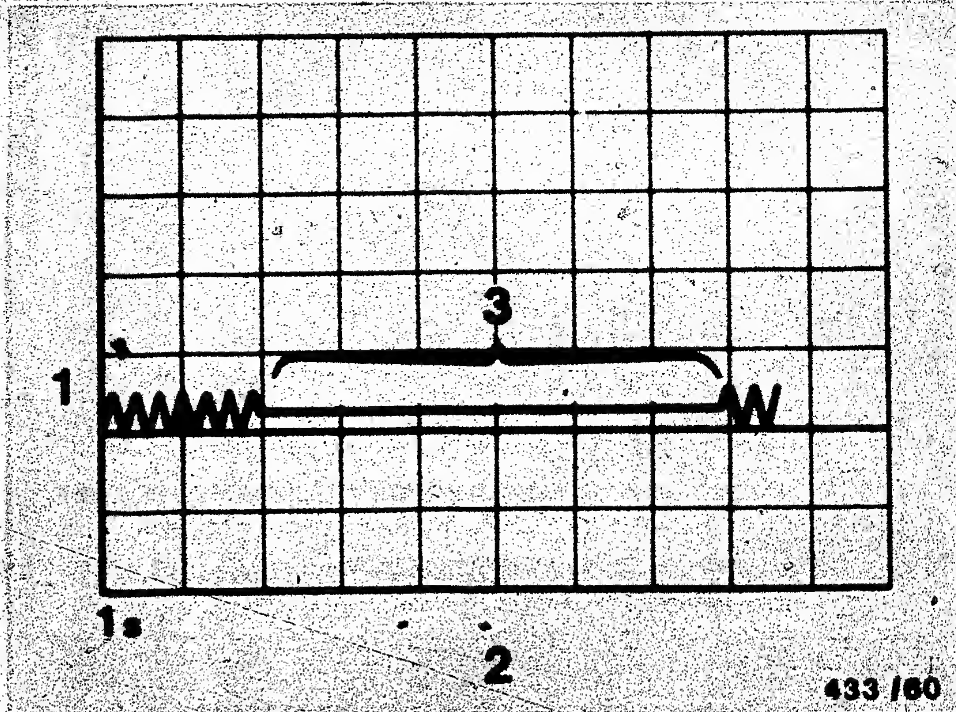


1 = Needle valve stroke
2 = Time for one downward movement of the hand lever (increasing testing speed)
3 = No chatter

Chatter characteristic group II

Chatter behavior:
Chattering well with rapid and slow lever speeds. In between, there can be smaller zones without chatter.

Spray pattern:
At low testing speed, broken sprays with coarse atomization. In the zone with no chatter, non-atomized cord spray. As the lever speed increases, the sprays become full and finely atomized.



1 = Needle valve stroke
2 = Time for one downward movement of the hand lever (increasing testing speed)
3 = No chatter and drips

Chatter characteristic group III

Chatter behavior:
Chattering only with slow or rapid movement of the lever. In between, there is a broad range without chatter.

Spray pattern:
Non-atomized cord spray up to a high testing speed. Then the sprays become full and finely atomized.

TABLE OF CONTENTS